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Inventory Development for Evaluation of Measures for the Control of Nontraditional Sources of Particulates in Southern New England

GCA Corp., Bedford, MA

Prepared for

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The results of this study can be used in an evaluation of control measures, reductions in particulate matter emissions, and likely air quality improvements at the study sites.

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INVENTORY DEVELOPMENT FOR EVALUATION OF MEASURES FOR THE CONTROL OF NONTRADITIONAL SOURCES OF PARTICULATES IN SOUTHERN NEW ENGLAND

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I
Air and Hazardous Materials Division
Boston, Massachusetts 02203

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INVENTORY DEVELOPMENT FOR EVALUATION OF MEASURES FOR THE CONTROL OF NONTRADITIONAL SOURCES OF PARTICULATES IN SOUTHERN NEW ENGLAND

Final Report

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Research Triangle Park
North Carolina 27711

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EPA Project Officer
Joseph A. McSorley

EPA Task Officer
Miriam Fastag

by
Fletcher G. Shives
Michael W. Kozenko

December 1978

GCA CORPORATION
GCA/TECHNOLOGY DIVISION
Bedford, Massachusetts

DISCLAIMER

This Final Report was furnished to the Environmental Protection Agency by GCA Corporation, GCA/Technology Division, Burlington Road, Bedford, Massachusetts 01730, in fulfillment of Contract No. 68-02-2607, Work Assignment No. 9. The opinions, findings, and conclusions expressed are those of the authors and not necessarily those of the Environmental Protection Agency. Mention of company or product names is not to be considered as an endorsement by the Environmental Protection Agency.

ABSTRACT

This report presents detailed micro-inventories of traditional and non-traditional sources of particulate matter within 5-mile and 1-mile radii, respectively, of each of 10 sites in New England. The 10 sites are located in Bridgeport, Hartford, and Waterbury, Connecticut; Boston, Fall River, Springfield, and Worcester (two sites), Massachusetts; Bangor, Maine and Providence, Rhode Island. Emissions data for traditional sources (point and area) were obtained from the most recently available state inventories for the area of concern. The data reporting format is principally that of the "Micro-inventories for TSP" draft report (T.G. Pace, U.S. EPA, Research Triangle Park, North Carolina).

The results of this study can be used in an evaluation of control measures, reductions in particulate matter emissions, and likely air quality improvements at the study sites.

CONTENTS

Abstract iii
Figures. vi
Tables vi

1. Introduction. 1
2. Methodology 2
   Site Survey. 2
   Emission Inventory 5
   Emission Factors 5
3. Site Inventories 10
   Bridgeport, Connecticut. 11
   Hartford, Connecticut. 18
   Waterbury, Connecticut 25
   Bangor, Maine. 32
   Boston, Massachusetts. 40
   Fall River, Massachusetts. 47
   Springfield, Massachusetts 54
   Worcester, Massachusetts 61
   Providence, Rhode Island 70

References 77
Appendices

A. Summary of Data Obtained from State and Local Agencies. 78
B. Streets for Which Traffic Volume Data Were Available. 79

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FIGURES

Number		Page
1	One-mile radius sectors for describing location of particulate sources and predominant land use classification	3

TABLES

1	Land Use Categories and Classification Criteria	4
2	Inventoried Fugitive Dust Source Categories	5
3	P-E Indices and Correction Factors	7
4	Adjusted Emission Factors for the New England Sites	9

SECTION 1

INTRODUCTION

Significant reductions in emissions of total suspended particulates (TSP) have occurred at many sources in New England since initiation of State Implementation Plans in 1972. Despite these reductions, several areas have continued to report violations of the National Ambient Air Quality Standards for TSP. It appears that nontraditional sources, sources not incorporated into the original State Implementation Plans, are significant contributors to the continued violations of the standards for TSP. A particularly suspect example of such a nontraditional source is the resuspension of particulate matter over heavily traveled roadways in urban areas.

The principal purpose of this program has been to prepare detailed microinventories of both traditional and nontraditional sources of particulate matter within 5-mile and 1-mile radii, respectively, of each of 10 sites in New England. The 10 sites are located in Bridgeport, Hartford, and Waterbury, Conn.; Boston, Fall River, Springfield, and Worcester (two sites) Mass.; Bangor, Maine and Providence, R.I.

Where possible, emissions of particulate matter have been quantified based on observations at each of the sites and emission factors for the various source categories. No emission factors were developed specifically for this program. However, for those source types for which more than one emission factor had been previously developed, a choice was made based on observed conditions at the present study sites. Emissions data for traditional sources (point and area) were obtained from the most recently available state inventories for the area of concern (see Appendix A). The data reporting format is principally that of the Microinventories for TSP Draft Report.[1]

The results of this study can be used in an evaluation of control measures, reductions in particulate matter emissions, and likely air quality improvements at the study sites.

Section 2 describes the methodology employed in preparing the inventories, which are presented in Section 3.

SECTION 2

METHODOLOGY

SITE SURVEY

Site visits were made to each of the 10 monitoring stations included in this study. Prior to the field observations, aerial photographs, topographical and planning maps were reviewed, and the appropriate state agencies were consulted to identify problem areas and known source categories. The area within a 1-mile radius of each site was carefully surveyed to determine the nature and extent of particulate matter sources. Because of the need to provide an indication of the position of the sources relative to the monitor sites, the 1-mile area was divided into sectors as depicted in Figure 1.

The area within one-quarter mile of the site was surveyed on foot to provide the greatest possible detail and to locate more precisely the smallest sources likely to have an impact on the monitor. A detailed map of the 1/4-mile area was also completed during this process. Additionally, photographs were made of the monitors showing the general nature of the location and nearby particulate matter sources. The photographs are included with the site inventories in this report.

The area from one-quarter mile to one mile was surveyed in lessor detail by driving each street segment within the several sectors. Source types were noted and their sizes and activity estimated.

The major source category for each of the areas was found to be related to vehicular travel. Quantification of the suspended particulate matter resulting from roadways depends upon the total vehicle miles traveled. This information was obtained from the appropriate traffic engineering department in the form of average daily traffic occurring along a specified road segment. When a road segment resided entirely within one sector, all the combustion and fugitive emissions resulting from that segment were added to that sector's totals. When a road segment crossed a boundary between sectors, the emissions were allocated to the sectors in proportion to the length of road segment in that sector. In most cases, accurate traffic counts were available only for major roadways (see Appendix B). Because roadway related particulate matter appeared to be the largest single nontraditional source, estimates of average daily traffic were made for some streets for which no data were available. Traffic volume data for the Connecticut sites, and Hartford in particular, were very sketchy to nonexistent.

The predominant land use for each sector was noted and this information is included in the site inventories. Table 1 lists the land use categories considered and their classification criteria.

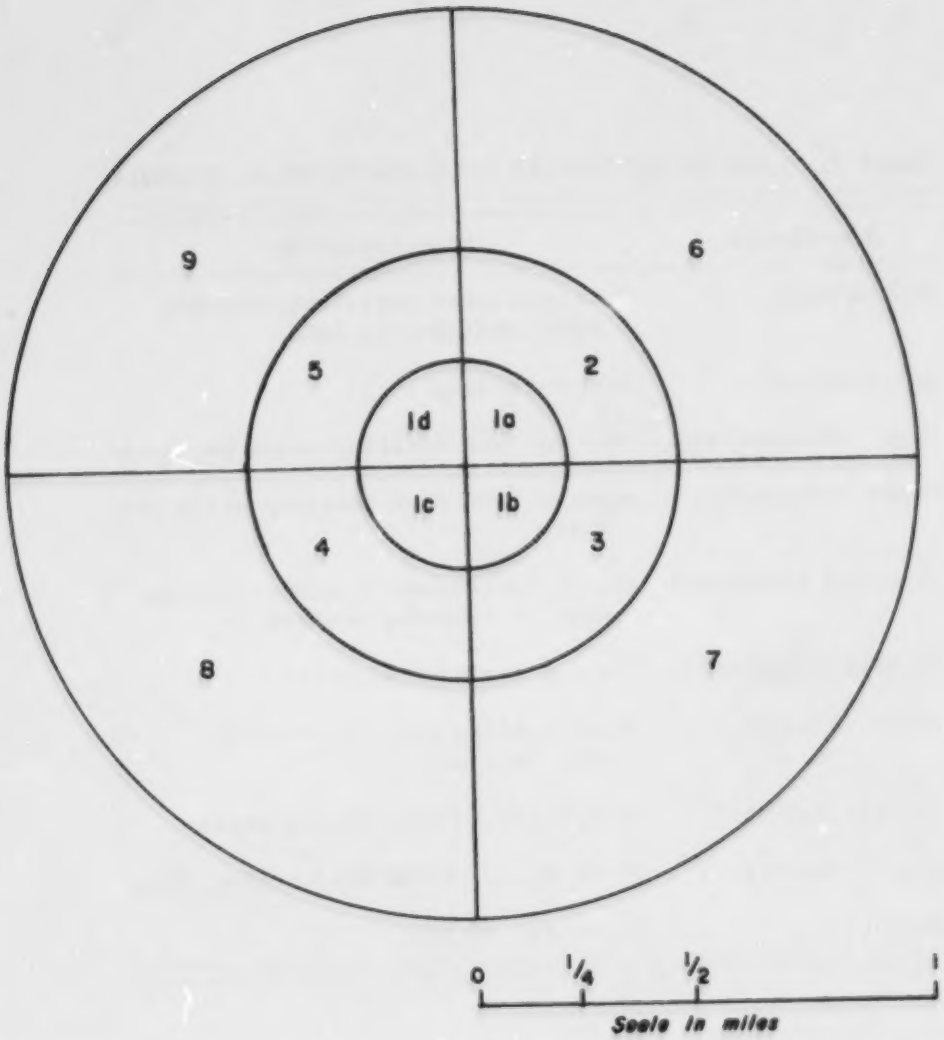


Figure 1. One-mile radius sectors for describing location of particulate sources and predominant land use classification.

TABLE 1. LAND USE CATEGORIES AND CLASSIFICATION CRITERIA

Descriptor	Characteristics
Undeveloped	No significant activity; includes parks and pasture land
Agriculture	Active farming
Light residential	Four or less dwelling units per acre
Dense residential	Greater than four dwelling units per acre
Suburban commercial	Retail businesses in strip development or shopping centers
Central commercial	Central business district
Light industry	Metal fabrication, warehousing, trucking, etc.
General industry	Controlled industrial processes
Heavy industry	Steel mills, foundries, coking, etc.
Airport	Municipal airport

EMISSION INVENTORY

Each site was surveyed for both traditional and nontraditional sources of particulate matter. Information on traditional point and area sources was obtained from the most recent state inventory files. Traditional sources were inventoried within a 5-mile radius of each site. Total emissions in tons per year, as well as distance and bearing from the monitor to the source, were determined for each source listed in the state inventory records. Sources smaller than 25 tons per year were included in the area source summaries.

Nontraditional (fugitive dust) sources were identified by observation (traveling either on foot or by automobile) of the area within 1 mile. Dust source categories observed and inventoried are listed in Table 2. There are no agricultural areas within the inventoried areas.

TABLE 2. INVENTORIED FUGITIVE DUST SOURCE CATEGORIES

Cleared areas
Construction
Railroad right-of-ways and yards
Reentrained dust from paved streets
Storage areas
Unpaved roads
Unpaved parking lots

EMISSION FACTORS

Emission factors chosen for the various source categories were those developed in previous studies by EPA contractors. For some of the source categories, paved streets being the most notable, several emission factors have been developed and employed in recent studies. Where a choice was possible, the emission factor to be applied was based upon observations of existing site conditions and the availability of required information. Because no emissions data have been generated by this study to verify or substantiate the applied emission factors, which were developed in other areas of the country, caution is advised in the interpretation and application of the results. This caution is particularly applicable to emissions determined for very heavily traveled streets such as interstate highways.

It is necessary to modify emission factors developed in one part of the country to account for climatological and soil type differences between the areas of concern. Climatological factors are considered by means of Thornthwaite's precipitation-evaporation (P-E) index.[2] The P-E index is calculated from the sum of 12 monthly ratios of measured precipitation to measured evapo-transpiration. Soil loss has been found to vary inversely as the square of the P-E index.

Table 3 depicts the P-E indices for the study sites and the emission factor source areas, as well as the P-E correction factors applied to the New England sites.

Emission factors for the various source types were obtained from several sources. Emission factors for railroad right-of-ways, cleared areas, storage areas, and unpaved parking lots, are those found in the Nevada Particulate Control Study for Air Quality Maintenance Areas.[3] For unpaved roads and construction sites, the factors are from Development of a Methodology and Emission Inventory for Fugitive Dust for the Regional Air Pollution Study.[4] The paved road emission factor is from the Regional Air Pollution Study Fugitive Dust Survey and Inventory.[5]

The following information details the applicability of each emission factor.

Railroad Right-of-Ways and Yards

This factor is from a study for Reno, Nevada (0.2 t/ac-yr) and assumes no vegetation, sandy soil, half the area is stabilized with an emission rate of 20 percent of the unstabilized area, and train traffic increases the wind erosion by 20 percent. An adjustment is made for the P-E index.

Unpaved Roads

This emission factor is from an MRI report for the Regional Air Pollution Study.

$$E = 0.49\ S_r \left(\frac{S_r}{30}\right)\left(\frac{d}{365}\right)$$

where S_r = silt content of road surface material (percent)

S_r = average vehicle speed (mph)

d = number of dry days per year

For this study the following assumptions were made:

vehicle speed = 20 mph

silt content = 12 percent

dry days = 240

$$E = 0.49\ (12)\left(\frac{20}{30}\right)\left(\frac{240}{365}\right) = 2.58\ \text{lb/VMT}$$

TABLE 3. P-E INDICES AND CORRECTION FACTORS

Study site	P-E index	Emission factor source area	P-E index	P-E correction factor
Boston	132	Reno	20	$\left(\frac{20}{132}\right)^2 = 0.03$
		St. Louis	93	$\left(\frac{93}{132}\right)^2 = 0.5$
Fall River	132	Reno	20	$\left(\frac{20}{132}\right)^2 = 0.03$
		St. Louis	93	$\left(\frac{93}{132}\right)^2 = 0.5$
Providence	132	Reno	20	$\left(\frac{20}{132}\right)^2 = 0.03$
		St. Louis	93	$\left(\frac{93}{132}\right)^2 = 0.5$
Bridgeport	139	Reno	20	$\left(\frac{20}{139}\right)^2 = 0.02$
		St. Louis	93	$\left(\frac{93}{139}\right)^2 = 0.4$
Hartford	141	Reno	20	$\left(\frac{20}{141}\right)^2 = 0.02$
		St. Louis	93	$\left(\frac{93}{141}\right)^2 = 0.4$
Waterbury	141	Reno	20	$\left(\frac{20}{141}\right)^2 = 0.02$
		St. Louis	93	$\left(\frac{93}{141}\right)^2 = 0.4$
Bangor	159	Reno	20	$\left(\frac{20}{159}\right)^2 = 0.02$
		St. Louis	93	$\left(\frac{93}{159}\right)^2 = 0.3$
Springfield	179	Reno	20	$\left(\frac{20}{179}\right)^2 = 0.01$
		St. Louis	93	$\left(\frac{93}{179}\right)^2 = 0.3$
Worcester	179	Reno	20	$\left(\frac{20}{179}\right)^2 = 0.01$
		St. Louis	93	$\left(\frac{93}{179}\right)^2 = 0.3$

Unpaved Parking Lots

This factor is from the Reno study and is derived from the equation for unpaved roads,

$$E = 0.49\ S_r \left(\frac{S_r}{30}\right)\left(\frac{d}{365}\right)$$

where E = emissions

S_r = silt content of road surface

S_r = vehicle speed

d = dry days per year

and assumptions on number of cars, distance traveled and vehicle speed.

The study assumes 20 cars per 10,000 square feet, 200 feet traveled, 250 days per year, yielding 817 vehicle miles traveled per acre. Further assumptions for this report include average vehicle speed of 10 mph, surface silt content of 12 percent, and 240 dry days per year.

$$E = 0.49\ (12)\left(\frac{10}{30}\right)\left(\frac{240}{365}\right) = 1.29\ \text{lb/VMT}$$

$$1.29\ (817) = 1{,}053\ \text{lb/ac-yr} = 0.53\ \text{t/ac-yr}$$

Cleared Areas

This factor is from the Reno study (0.24 t/ac-yr) and assumes clay-loam soil and no vegetation. An adjustment is made for the P-E index.

Storage Areas

From the Reno study (1.9 t/ac-yr), it includes storage piles, loading and unloading, haul roads and traffic areas, excavation, and equipment parking. An adjustment is made for the P-E index.

Construction

This emission factor is also from the MRI report (1.0 t/ac-mo) and assumes construction time of 9 months and is adjusted for the P-E index.

Paved Roads

This factor is from the Rockwell report which assigns a level of 5 g/VMT to clean paved streets. Because of the arbitrary nature of determining the relative cleanliness of streets and because of the general uniformity of the street traffic types for each of the sites, a factor of 5 g/VMT was used for all streets in this study.

Table 4 lists the source type emission factors (adjusted for P-E index) for each of the study sites.

TABLE 4. ADJUSTED EMISSION FACTORS FOR THE NEW ENGLAND SITES

Study site	Source category emission factors						
	Railroad right-of-way (t/ac-yr)	Paved streets (g/VMT)	Unpaved roads (lb/VMT)	Cleared areas (t/ac-yr)	Construction (t/ac-mo)	Storage areas (t/ac-yr)	Unpaved parking (t/ac-yr)
Boston, Fall River, Providence	0.005	5	2.58	0.006	0.496	0.044	0.526
Hartford, Waterbury	0.004	5	2.58	0.005	0.435	0.038	0.526
Bridgeport	0.004	5	2.58	0.005	0.448	0.040	0.526
Bangor	0.003	5	2.58	0.004	0.342	0.030	0.526
Springfield, Worcester	0.002	5	2.58	0.003	0.270	0.023	0.526

SECTION 3

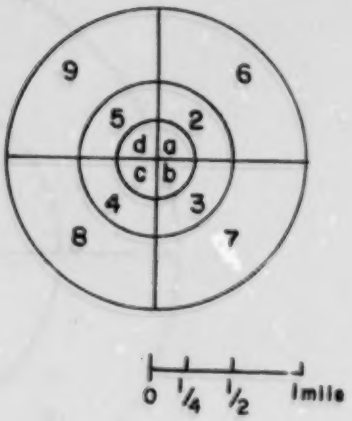
SITE INVENTORIES

DESCRIPTION OF SITE

SAROAD code - F 07 0060 123

Location - Hallet Street, Bridgeport, Connecticut
UTM-E-653000, N-4560750

Monitor height - 15 ft, on trailer roof



Land use, by sector -

1a - General industry, dense residential
1b - Dense residential
1c - Dense residential
1d - Dense residential

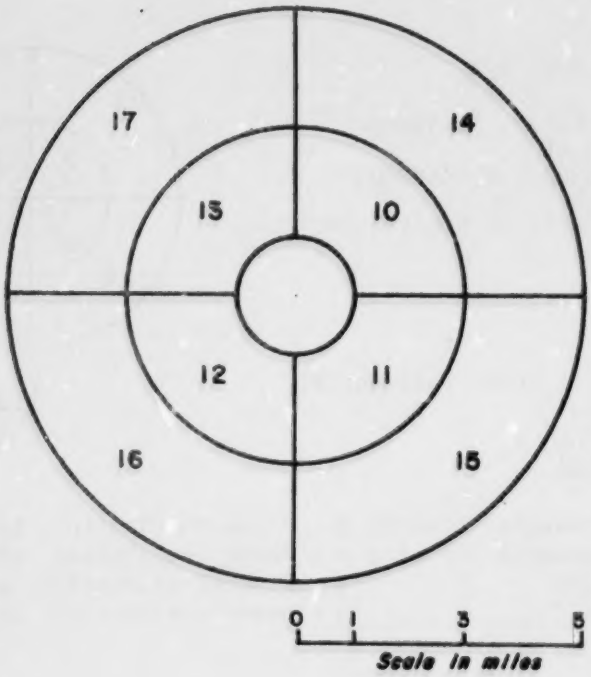
2 - Dense resid., general industry
3 - Dense resid., general industry
4 - Dense residential
5 - Dense residential
6 - Dense residential, general industry
7 - Dense residential, general industry
8 - Central commercial, general industry
9 - Dense residential, general industry

Localized sources, within 200 ft of monitor -

Source	Distance	Description
Hallet Street	35 ft	1,200 ADT, commercial/residential, curbed
Barnum Avenue	136 ft	6,500 ADT, commercial/residential, curbed
Railroad right-of-way	180 ft	2 tracks, frequent traffic
Steel storage yard	70 ft	1.5 ac paved lot
Tractor-trailer training school	30 ft	1.5 ac paved lot, diesel truck operation
East Washington Street	155 ft	ADT unknown, low volume, commercial, curbed

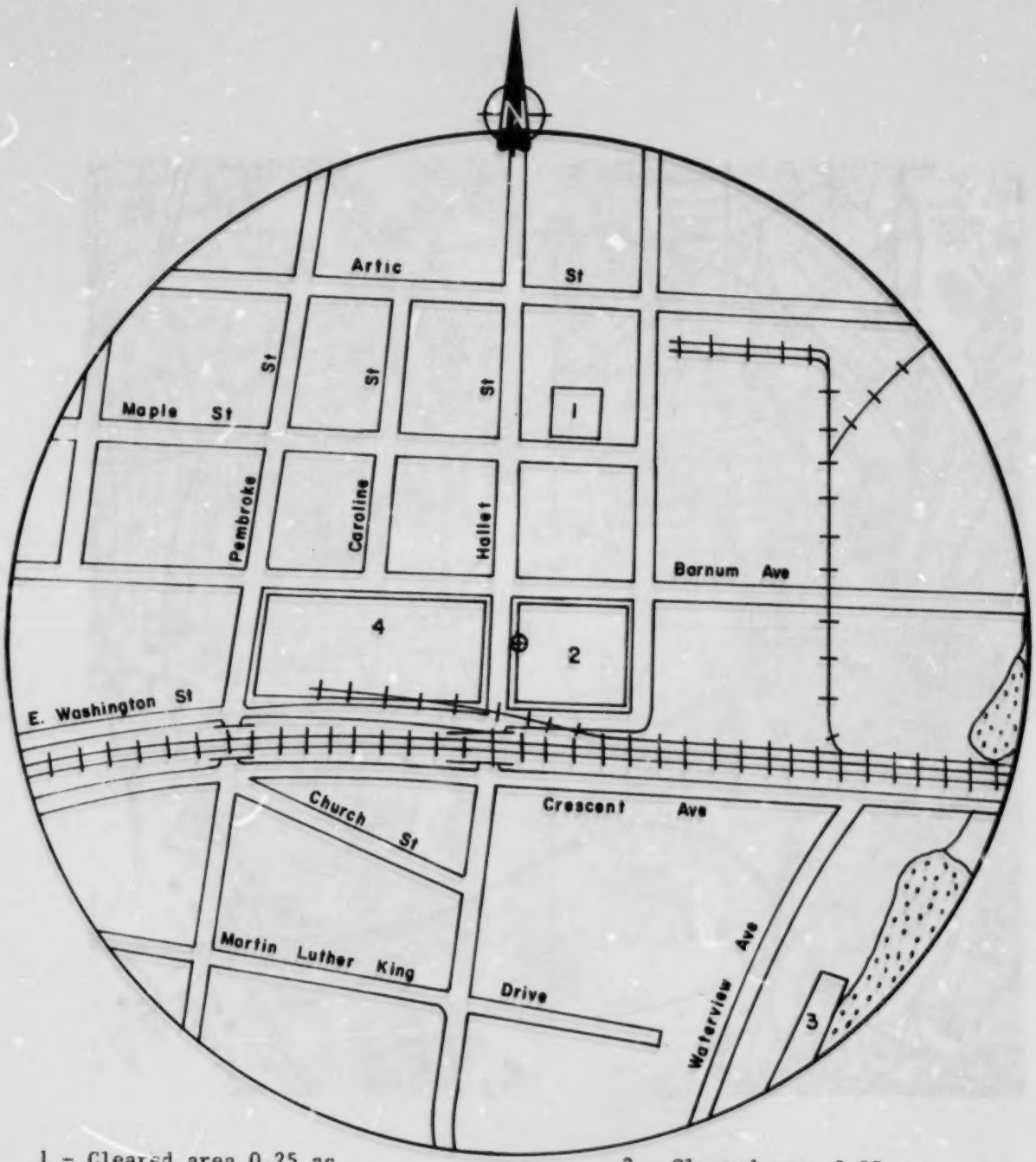
Air quality data -

Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	71	119
1976	68	60
1975	66	38
1974	-	-
1973	-	-



Sector	Land use	Emissions (t/yr) Commercial/Industrial	Residential
10	Dense residential		
11	Dense residential, light industry		
12	Dense residential, general indus.		
13	Dense residential	(State inventory not available)	
14	Dense residential		
15	Residential, Long Island Sound		
16	Residential, Long Island Sound		
17	Dense residential		

Land use and area emissions by sector,
Hallet Street, Bridgeport, Connecticut.



1 - Cleared area 0.25 ac

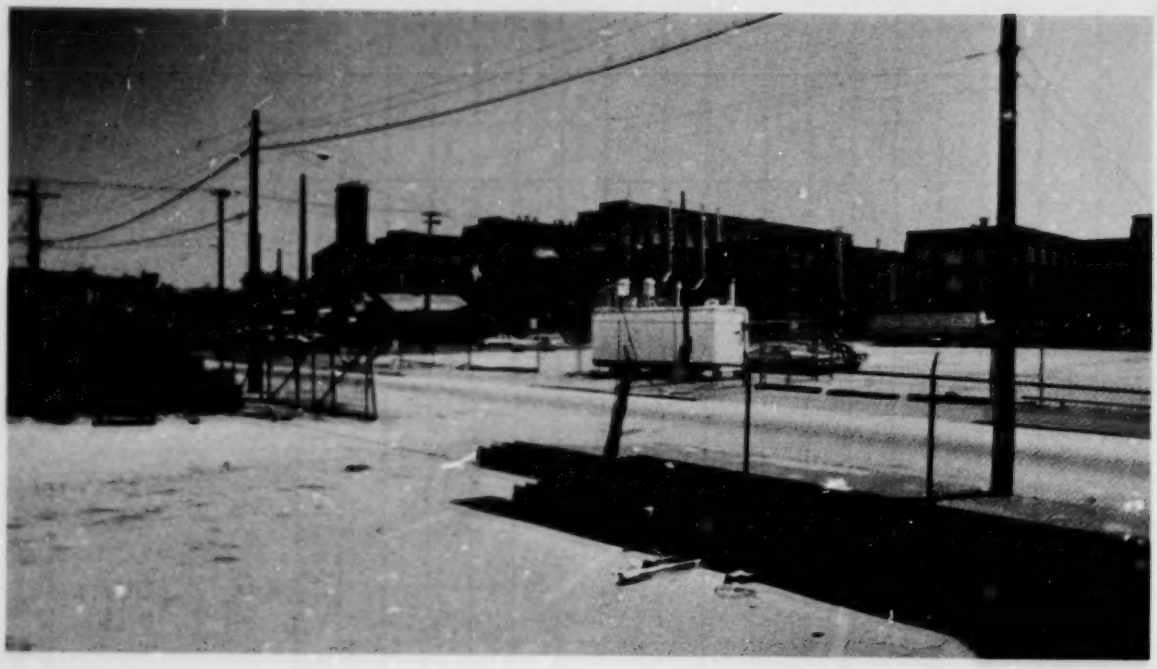
2 - Tractor-trailer training school (paved lot) 2 ac

3 - Cleared area 0.25 ac

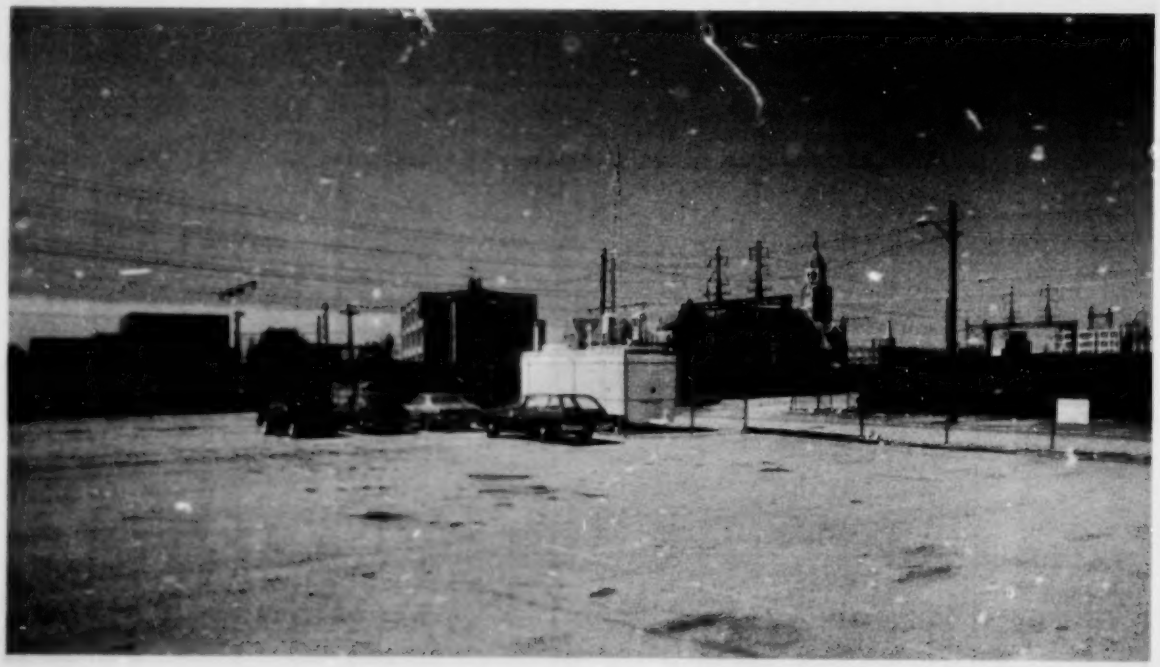
4 - Steel storage yard, 5 ac (paved lot)

One-quarter mile radius around Hallet Street site, Bridgeport, Connecticut

One-mile radius around Hallet Street site, Bridgeport, Connecticut.



Hallet St., Bridgeport, Ct., View to Northeast.



Hallet St., Bridgeport, Ct., View to Southwest.

AREA SOURCE SUMMARY

Site: Hallet Street, Bridgeport, Connecticut

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION: *											
Residential fuel											
Comm/Ind fuel											
Incinerators											
Auto exhaust	90.0×10^6 VMT	1.2	1.0	0.6	6.0	0.5	6.3	17.2	24.2	5.3	62.3
IND PROCESSES: *											
Ind processes											
FUGITIVE DUST:											
Railroad yards	33.0 ac	neg.	neg.	neg.	neg.		neg.	0.1	neg.	neg.	0.1
Paved streets †	90.0×10^6 VMT	12.5	8.5	5.4	19.0	4.1	53.2	146.0	205.3	44.9	498.9
Unpaved roads											
Cleared areas	6.0 ac	neg.			neg.	neg.	neg.	neg.	neg.	neg.	neg.
Construction	6.3 ac		17.1				2.0			6.0	25.1
Storage areas	14.3 ac	0.2		0.1				0.3	neg.		0.6
Unpaved pkg lots	9.8 ac			0.3	0.3		0.3	0.1	2.0	2.2	5.2

Recap	Emissions by sector, t/yr			
	1	2 to 5	6 to 9	Total
COMBUSTION	1.2	8.1	53.0	62.3
IND PROCESSES				
FUGITIVE DUST	12.7	54.8	462.4	529.9
Total	13.9	62.9	515.4	592.2

*State inventory not available. (See Appendix A).

†Limited data base. (See Appendix B).

POINT SOURCE SUMMARY

Site: Hallet Street, Bridgeport Connecticut

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °

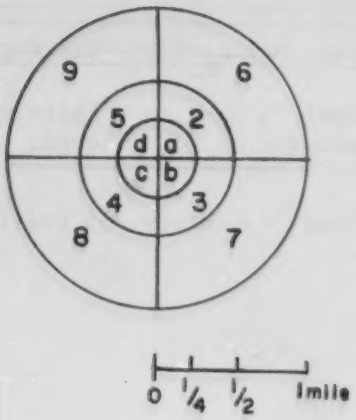
(State inventory not available)

DESCRIPTION OF SITE

SAROAD code - F 07 0420 003

Location - Hartford Public Library, Main Street at I-484, Hartford, Conn. UTM-E-693300, N-4625800

Monitor height - 30 ft, roof of three-story building



Land use, by sector -

1a - Central commercial
1b - Light industry
1c - Central commercial
1d - Central commercial

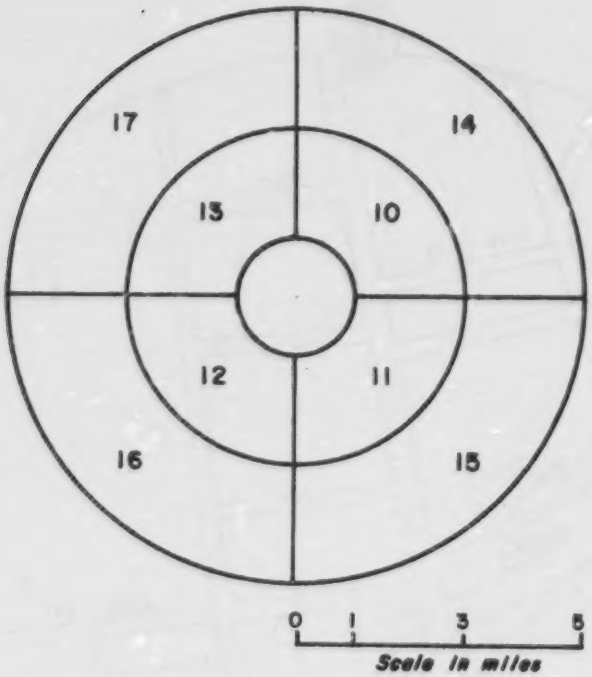
2 - Central commercial
3 - Dense residential
4 - Dense residential
5 - Central commercial
6 - Suburban commercial
7 - Dense residential, light industry
8 - Dense residential
9 - Central commercial

Localized sources, within 200 ft of monitor -

Source	Distance	Description
Main Street	200 ft	ADT unknown, commercial, curbed
I-484	64 ft	17,000 ADT, commercial, curbed, (runs under building)

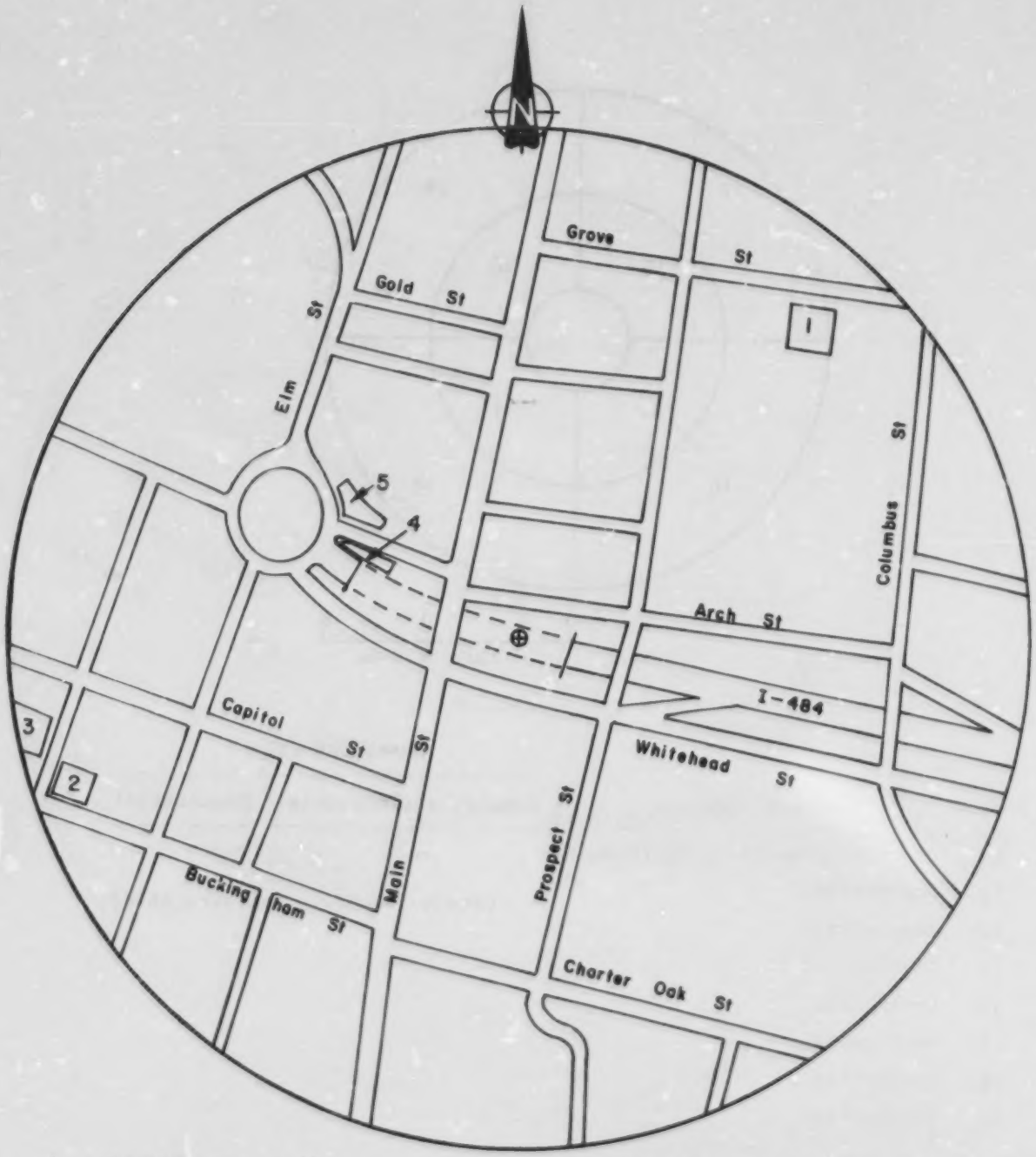
Air quality data -

Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	66	105
1976	74	58
1975	68	60
1974	62	55
1973	81	33



Sector	Land use	Emissions (t/yr)	
		Commercial/Industrial	Residential
10	Central commercial, residential	(State inventory not available)	
11	Residential		
12	Residential		
13	Residential		
14	Residential		
15	Residential		
16	Residential		
17	Residential		

Land use and area emissions by sector,
Public Library site, Hartford, Connecticut.



1 - Cleared area, 0.25 ac

2 - Unpaved parking, 0.25 ac

3 - Unpaved parking, 0.5 ac

4 - Unpaved parking, 0.25 ac

5 - Construction, 0.25 ac

One-quarter mile radius around Public Library site, Hartford, Connecticut.

One-mile radius around Public Library site, Hartford, Connecticut.

Public Library, Hartford, Ct., View to Northwest.

Public Library, Hartford, Ct., View to Southeast.

AREA SOURCE SUMMARY

Site: Public Library, Hartford, Connecticut

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION: *											
Residential fuel											
Comm/Ind fuel											
Incinerators											
Auto exhaust											
IND PROCESSES: *											
Ind processes											
FUGITIVE DUST:											
Railroad yards	36.0 ac		neg.	neg.			0.1	neg.		0.1	0.2
Paved streets †											
Unpaved roads											
Cleared areas	6.1 ac	neg.		neg.	neg.		neg.	neg.	neg.	neg.	
Construction	8.0 ac	1.0	11.7				1.0	3.9	3.9	9.8	31.3
Storage areas	1.5 ac							0.1			0.1
Unpaved pkg lots		0.5		1.8	0.8		3.8	0.1	0.4	1.6	9.0

Recap	Emissions by sector, t/yr			
	1	2 to 5	6 to 9	Total
COMBUSTION				
IND PROCESSES				
FUGITIVE DUST	1.5	14.3	24.8	40.6
Total	1.5	14.3	24.8	40.6

*State inventory not available. (See Appendix A).

†Insufficient data vailable. (See Appendix B).

POINT SOURCE SUMMARY

Site: Public Library, Hartford, Connecticut

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, °

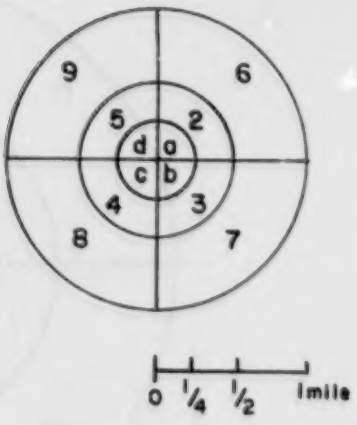
(State inventory not available)

DESCRIPTION OF SITE

SAROAD code - F 07 1240 123

Location - I-84 Interchange 21,
Waterbury, Connecticut
UTM-E-663125, N-4601450

Monitor height - 15 ft, on trailer roof



Land use, by sector -

1a - Central commercial
1b - Central commercial, dense residential
1c - Light industry
1d - Light industry

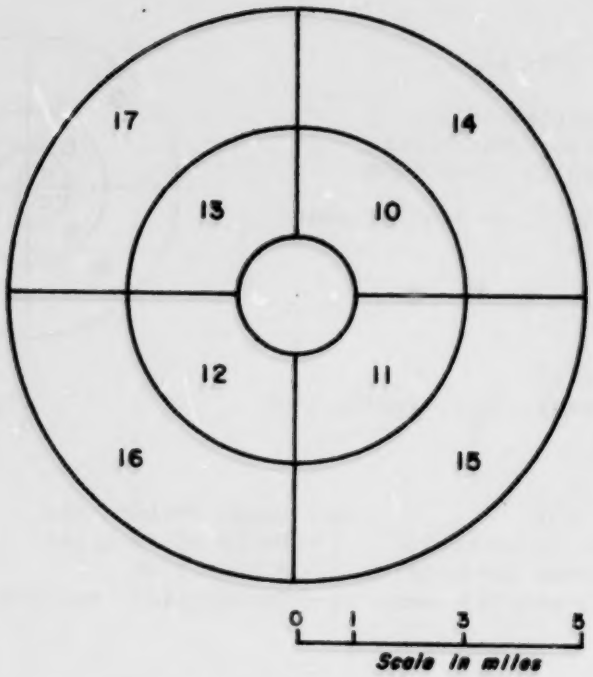
2 - Central commercial
3 - Light industry, dense resid.
4 - Undeveloped, dense residential
5 - Light industry, central comm.
6 - Dense residential
7 - Dense residential
8 - Residential
9 - Residential, suburban commercial

Localized sources, within 200 ft of monitor -

Source	Distance	Description
I-84 ramp	100 ft	8,900 ADT, paved, curbed
Bank Street	80 ft	6,900 ADT, paved, curbed
Meadow Street	60 ft	7,400 ADT, paved, curbed

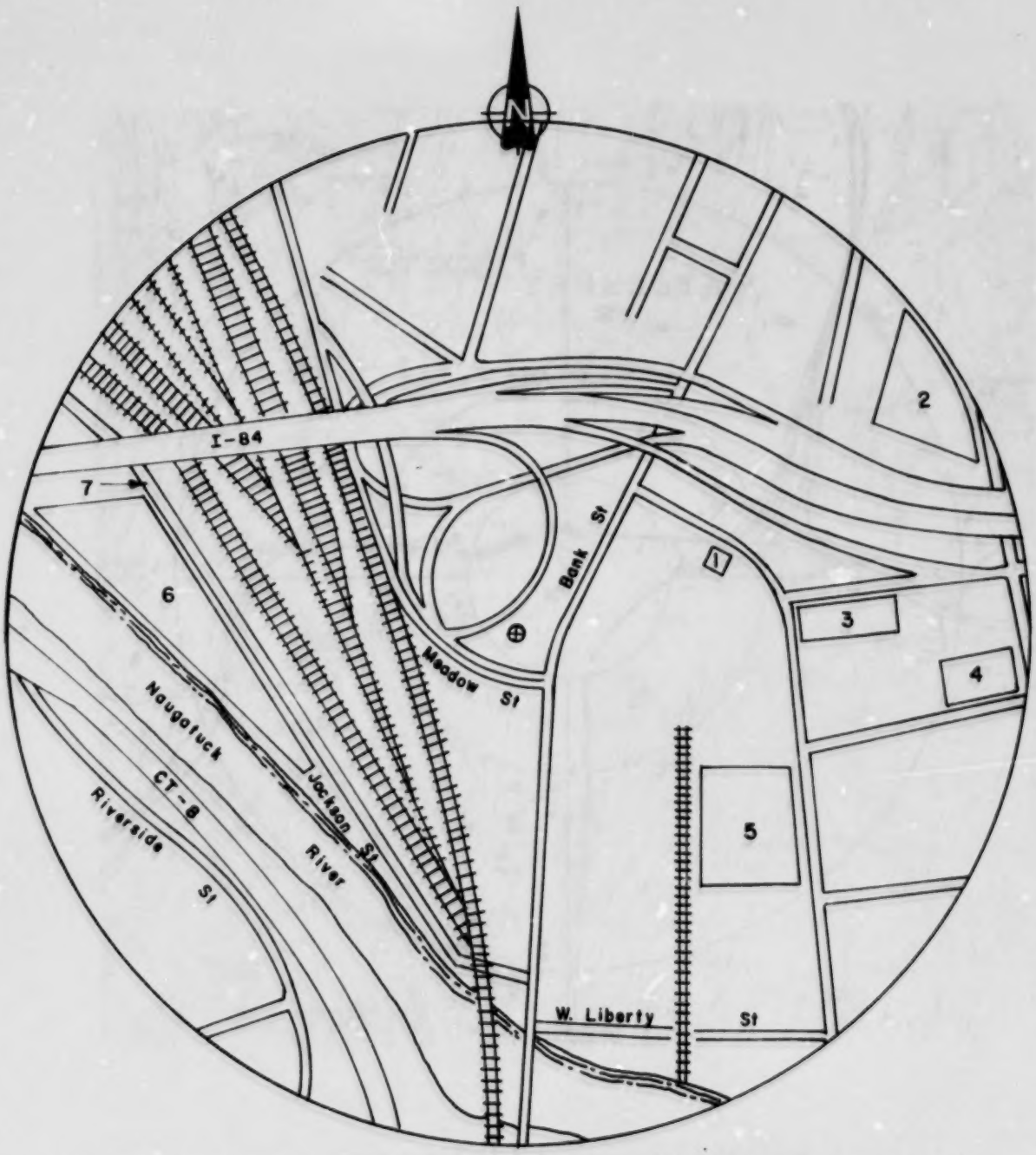
Air quality data -

Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	81	118
1976	86	60
1975	85	37
1974	-	-
1973	-	-



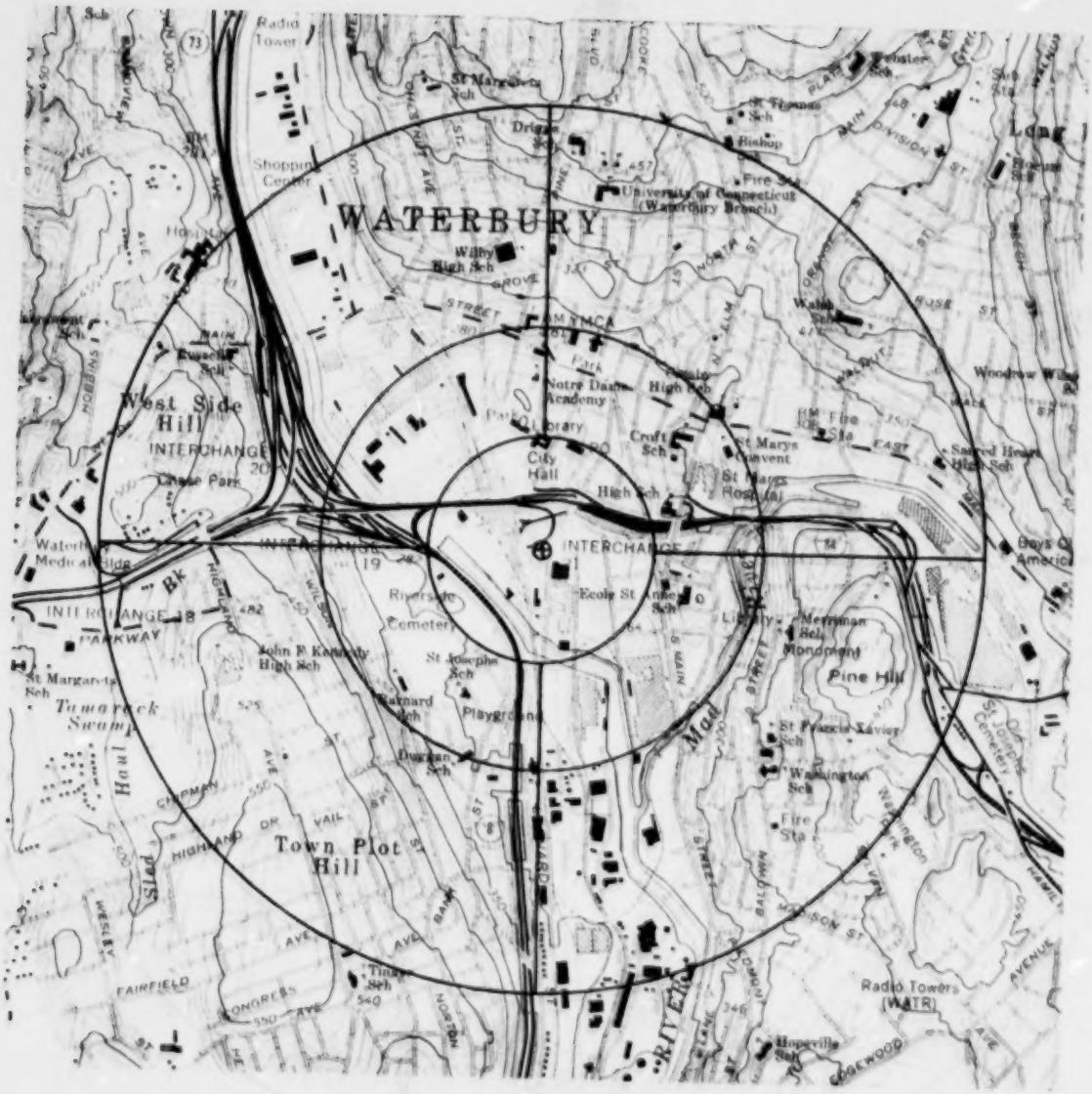
Sector	Land use	Emissions (t/yr)	
		Commercial/Industrial	Residential
10	Residential	(State inventory not available)	
11	Residential		
12	Residential		
13	Residential		
14	Residential		
15	Residential		
16	Residential, undeveloped		
17	Residential		

Land use and area emissions by sector,
I-84 Interchange site, Waterbury, Connecticut.



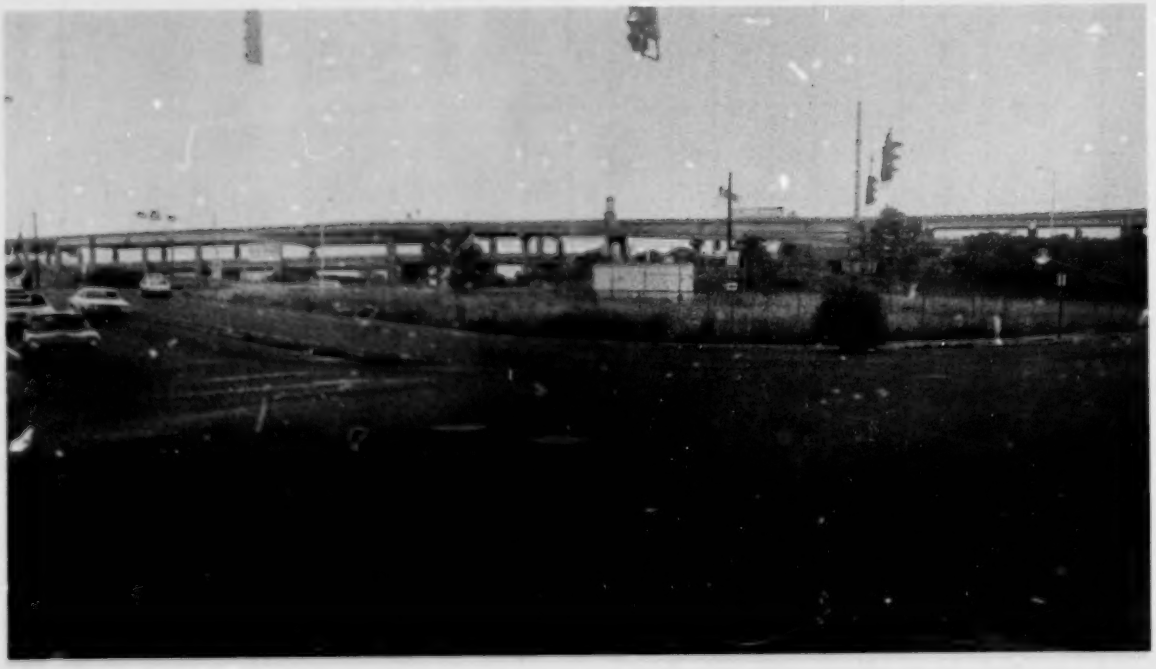
1 - Unpaved parking, 0.1 ac
2 - Unpaved parking, 1.0 ac
3 - Construction, 0.25 ac
4 - Cleared area, 0.5 ac
5 - Lumberyard, aggregate storage, 1.25 ac
6 - School bus storage, unpaved parking, 2.0 ac
7 - Dirt road, 0.1 mi

One-quarter mile radius around I-84 Interchange, Waterbury, Connecticut.



One-mile radius around I-84 Interchange site, Waterbury, Connecticut.

I-84 Interchange, Waterbury, Ct., View to Northeast.



I-84 Interchange, Waterbury, Ct., View to Northwest.

AREA SOURCE SUMMARY

Site: I-84 Interchange, Waterbury, Connecticut

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION: *											
Residential fuel											
Comm/Ind fuel											
Incinerators											
Auto exhaust	77.1×10^6 VMT	8.2	4.3	1.0	No Data	4.9	6.7	9.1	5.4	10.7	50.3
IND PROCESSES: *											
Ind processes											
FUGITIVE DUST:											
Railroad yards	29.6 ac	neg.		neg.	neg.	0.1	neg.	neg.		neg.	0.1
Paved streets †	77.1×10^6 VMT	69.4	36.7	8.2	No Data	41.1	56.4	77.0	45.5	91.0	425.3
Unpaved roads	2.9×10^3 VMT	3.7									3.7
Cleared areas	1.0 ac	neg.		neg.			9.8				9.8
Construction	4.75 ac	1.0	7.8								8.8
Storage areas	6.75 ac	0.1				neg.		neg.		0.1	0.2
Unpaved pkg lots	11.0 ac	0.6	0.1	1.6	0.1	0.4	1.3	0.4		1.2	5.7

Recap	Emissions by sector, t/yr			
	1	2 to 5	6 to 9	Total
COMBUSTION	8.2	10.2	31.9	50.3
IND PROCESSES				
FUGITIVE DUST	74.8	96.1	282.7	453.6
Total	83.0	106.3	314.6	503.9

*State inventory not available. (See Appendix A).

†Limited data base. (See Appendix B).

POINT SOURCE SUMMARY

Site: I-84 Interchange, Waterbury, Connecticut

Plant number	Emission level, t/yr	Distance from site, mi	Compass direction, ^{o}

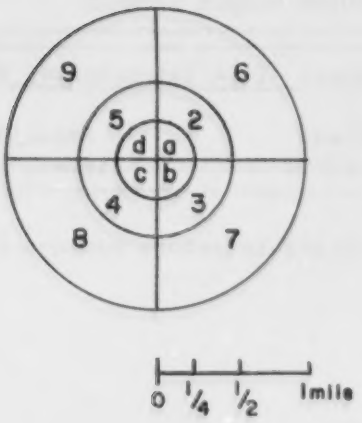
(State inventory not available)

DESCRIPTION OF SITE

SAROAD code - 20 0100 001 F01

Location - 31 Central Street, Bangor, Maine
UTM-E-519144, N-4960781.

Monitor height - 48 ft., on roof of three-story building.



Land use, by sector -

1a - Central commercial
1b - Central commercial
1c - Central commercial
1d - Central commercial

2 - Dense residential
3 - Light industry
4 - Light industry, dense resid.
5 - Dense residential
6 - Dense residential
7 - Central commercial, dense residential
8 - Dense residential, light industry
9 - Dense residential

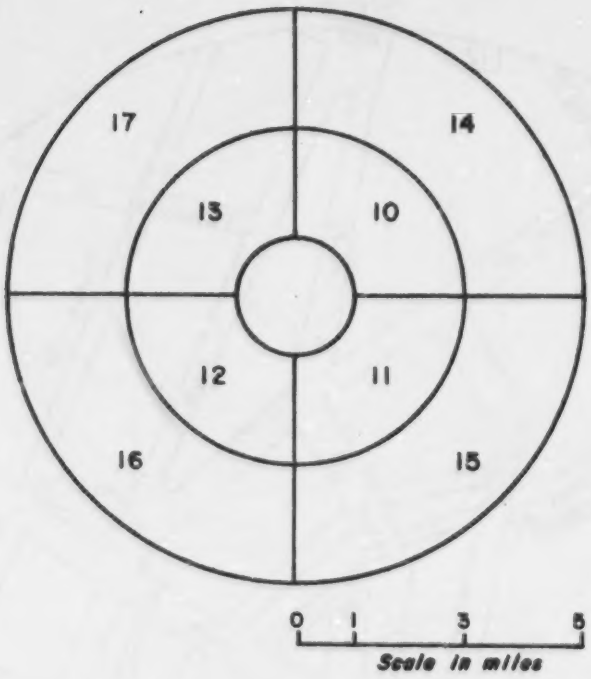
Localized sources, within 200 ft of monitor -

Source	Distance	Description
Central Street	36 ft	10,600 ADT, commercial, curbed
Boiler stack	45 ft	building heat, oil-fired, 8 ft above roof
Unpaved parking lot	150 ft	0.25 ac, 30 cars

Air quality data -

Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	55	109
1976	61	56
1975	62	59
1974	52	60
1973 *	74	41

* 17 March to 31 December.



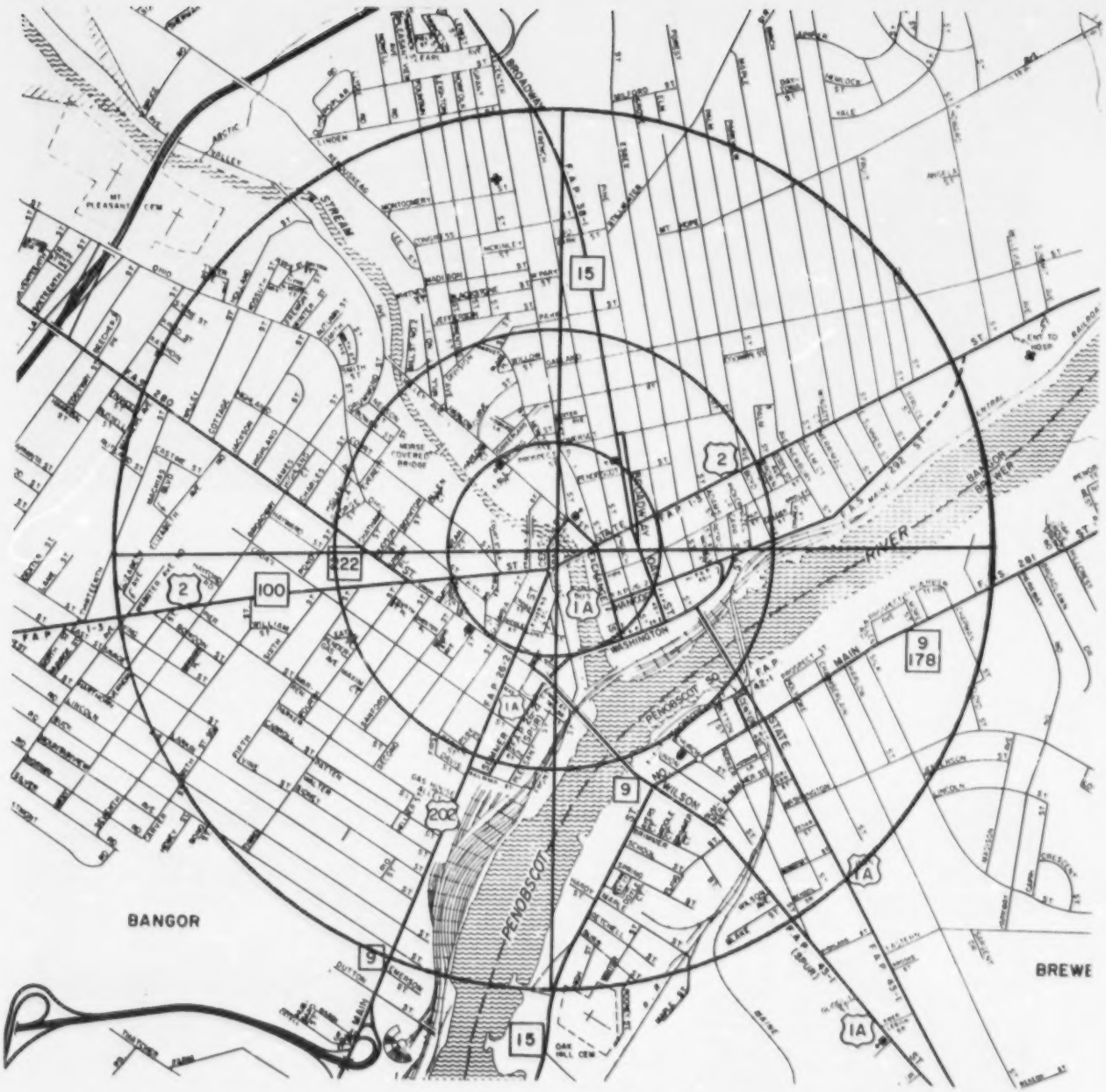
Sector	Land use	Emissions (t/yr)	
		Commercial/Industrial	Residential
10	Residential, undeveloped	35.2	4.1
11	Residential, undeveloped	0.3	0.3
12	Residential, undeveloped	13.0	11.5
13	Residential, undeveloped	41.0	8.8
14	Undeveloped	-	-
15	Undeveloped	-	-
16	Undeveloped	2.4	-
17	Undeveloped	0.6	-

Land use and area emissions by sector, Bangor, Maine.

1. Unpaved lot, 0.25 ac
2. Unpaved lot, 0.25 ac
3. Unpaved lot, 1.0 ac*
4. Unpaved lot, 0.5 ac*
5. Unpaved lot, 0.5 ac*
6. Unpaved lot, 1.0 ac
7. Unpaved lot, 0.05 ac
8. Unpaved lot, 0.2 ac
9. Unpaved lot, 0.2 ac
10. Unpaved lot, 0.2 ac*
11. Unpaved lot, 0.8 ac
12. Unpaved lot, 0.1 ac

*Paved summer 1978, 0.2 ac still unpaved of No. 3.

One-quarter mile radius around 31 Central Street, Bangor, Maine.



One mile radius around 31 Central Street, Bangor, Maine.

31 Central St., Bangor, Me., View to Northwest.

31 Central St., Bangor, Me., View to Southeast.

AREA SOURCE SUMMARY

Site: 31 Central Street, Bangor, Maine

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel	3.2×10^3 D.U.	2.5	3.8	0.8	3.2	2.0	13.8	4.3	12.4	13.1	55.9
Comm/Ind fuel	1.6×10^6 gal.	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.1	1.5
Incinerators	2						neg.			0.8	0.8
Auto exhaust	59.9×10^6 VMT	5.3	1.9	4.5	3.9	1.6	4.3	8.9	3.8	4.6	38.8
IND PROCESSES:											
Ind processes											
FUGITIVE DUST:											
Railroad yards	43.0ac			neg.			neg.	neg.	0.1		0.1
Paved streets	59.9×10^6 VMT	44.8	16.4	38.2	22.8	13.4	36.6	75.7	32.5	39.0	319.4
Unpaved roads						neg.			neg.		neg.
Cleared areas	14.5ac		neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
Construction	5.8ac		15.4	1.5					0.8		17.7
Storage areas											
Unpaved pkg lots	11.0ac	2.6*	0.3		0.3		1.6	0.9	0.1		5.8

Recap	Emissions by sector, t/yr			
	1	2 to 5	6 to 9	Total
COMBUSTION	8.1	22.4	66.5	97.0
IND PROCESSES				
FUGITIVE DUST	47.4	108.3	187.3	343.0
Total	55.5	130.7	253.8	440.0

*Lots 3, 4, 5, and 10 were paved during the summer of 1978, reducing the sector emissions by 1.0 ton/yr.

POINT SOURCE SUMMARY

Site: 31 Central Street, Bangor, Maine

Plant number	Emission level, t/yr*	Distance from site, mi	Compass direction, °
19	0.1	0.12	250
57	0.1	1.6	160
106	0.4	2.2	240
107	0.9	3.3	190
108	1.8	0.8	195
109	1.3	1.0	205
110	2.0	2.2	345
111	0.4	3.2	195
112	0.3	1.6	245
113	0.6	1.0	260
114	0.5	0.62	225
115	0.7	0.63	360
116	1.0	0.20	335
117	0.9	0.29	035
118	0.8	0.28	185
119	2.3	1.1	190
120	9.7	1.9	050
121	1.6	2.4	035
122	0.5	1.3	200
123	0.4	1.6	340
124	0.6	0.83	235
125	0.6	1.3	210
126	1.0	0.98	025
127	0.4	3.5	260
128	0.7	3.4	255
129	0.2	1.5	345
130	0.3	0.15	345
131	0.6	3.5	315
132	0.4	1.1	040
133	0.3	0.60	055
134	0.5	1.0	355
135	0.3	1.1	275
136	0.8	1.8	295
137	0.6	2.1	030
138	2.5	1.0	045
139	16.9	1.8	290
140	16.9	1.8	295
141	138.1	2.2	070
142	9.7	1.9	050
143	2.5	1.2	190

POINT SOURCE SUMMARY

Site: 31 Central St., Bangor, Maine

Plant number	Emission level, t/yr*	Distance from site, mi	Compass direction, °
144	99.6	2.2	195
145	11.2	1.2	065
146	1.6	2.4	040
147	1.0	0.99	135
148	1.0	2.5	290
149	0.8	1.9	325
154	2.9	0.84	360
155	1.2	1.7	310
157	0.5	0.49	240

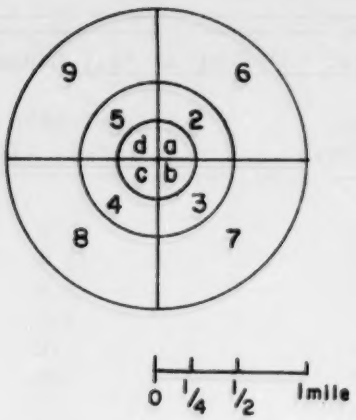
*Sources less than 25 t/yr are included with area source summary.

DESCRIPTION OF SITE

SAROAD code - 22 0240 002 F01

Location - Kenmore Square, Boston,
Massachusetts
UTM-E-327228, N-4690420

Monitor height - 14 ft, on trailer roof



Land use, by sector -

1a - Central commercial, dense residential
1b - Central commercial
1c - Central commercial
1d - Central commercial, dense residential

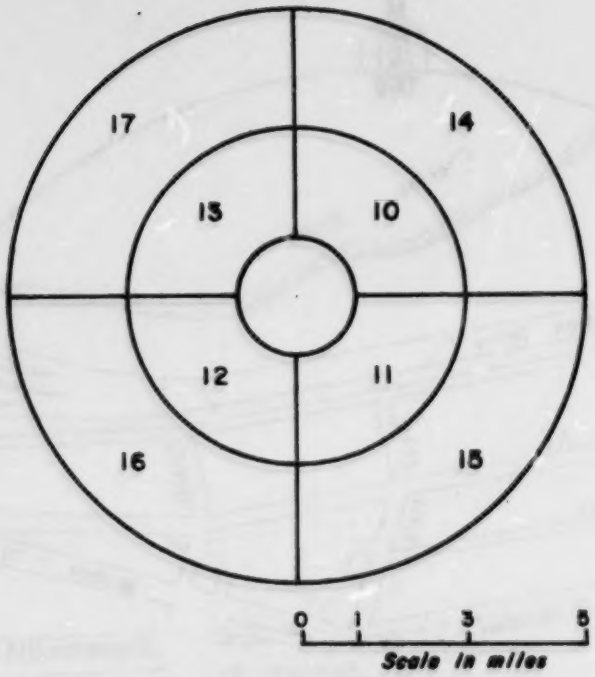
2 - Dense residential, Charles River
3 - Central commercial, dense resid.
4 - Dense resid., central commercial
5 - Dense residential, central commercial, Charles River
6 - Dense residential, Charles River
7 - Central commercial, dense residential
8 - Dense residential
9 - Dense residential

Localized sources, within 200 ft of monitor -

Source	Distance	Description
Commonwealth Avenue	20 ft	24,000 ADT, paved, curbed
Beacon Street	150 ft	19,000 ADT, paved, curbed
Brookline Avenue	200 ft	17,000 ADT, paved, curbed
Deerfield Street	150 ft	2,000 ADT, paved, curbed

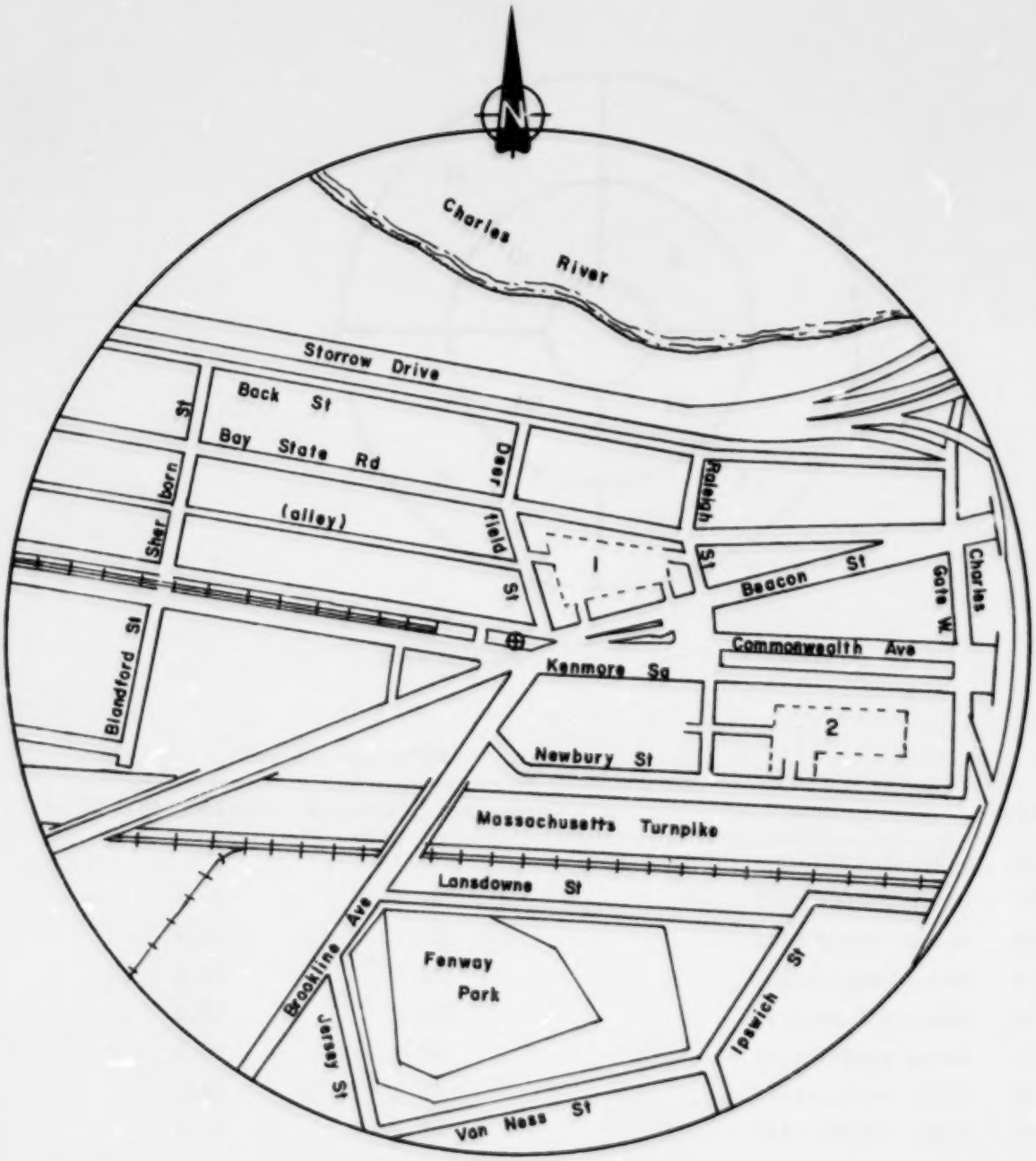
Air quality data -

Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	80	43
1976	98	62
1975	99	42
1974	84	74
1973	114	73



Sector	Land use	Emissions (t/yr)	
		Commercial/Industrial	Residential
10	Central commercial,dense resid.	250.0	10.5
11	Dense residential	197.3	16.8
12	Dense residential	104.1	19.9
13	Dense residential	128.0	15.2
14	General industry	242.2	18.0
15	Dense residential	97.5	28.7
16	Dense residential	87.8	26.1
17	Dense residential	148.8	41.1

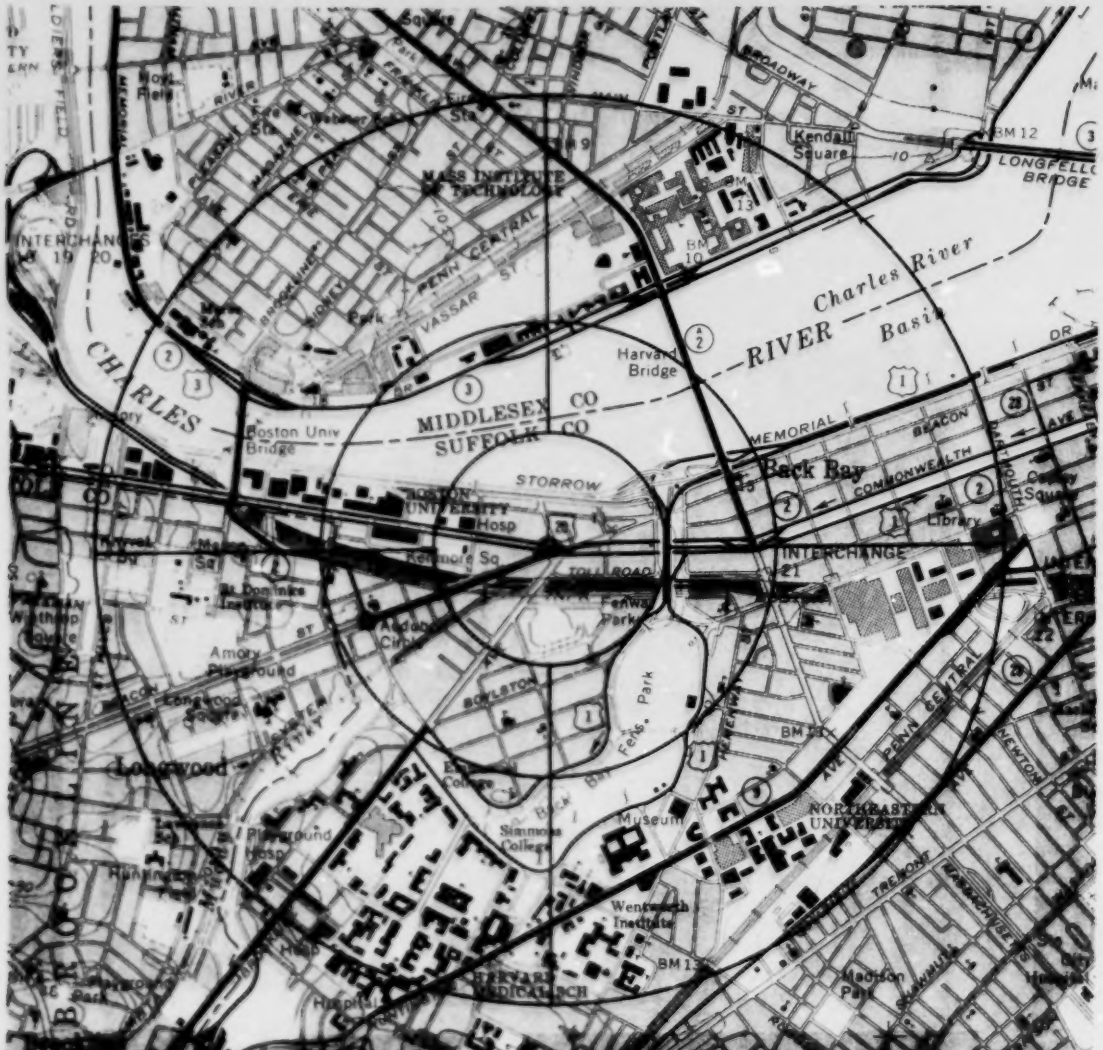
Land use and area emissions by sector,
Kenmore Square, Boston, Massachusetts.



1 - Partially paved parking, 0.5 ac

2 - Partially paved parking, 0.5 ac

One-quarter mile radius around Kenmore Square, Boston, Massachusetts.



One-mile radius around Kenmore Square site, Boston, Massachusetts.

Kenmore Square, Boston, Mass., View to Northeast.

AREA SOURCE SUMMARY

Site: Kenmore Square, Boston, Massachusetts

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel	4.4×10^6 gal.	0.3	0.2	0.2	0.2	0.3	0.6	1.4	0.8	1.6	5.6
Comm/Ind fuel	18.7×10^6 gal	7.0	4.4	1.4	5.1	1.8	10.7	15.5	22.4	8.8	77.1
Incinerators											
Auto exhaust	233.7×10^6 VMT	24.3	13.3	9.8	6.4	7.7	21.0	21.0	15.5	32.8	151.8
IND PROCESSES:											
Ind processes											
FUGITIVE DUST:											
Railroad yards	20.1 ac	neg.		neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
Paved streets	233.7×10^6 VMT	205.9	112.5	82.7	54.4	66.2	178.4	177.6	131.1	278.2	1287.0
Unpaved roads											
Cleared areas	12.6 ac			neg.	neg.		neg.	neg.	neg.	neg.	neg.
Construction	5.5 ac							21.2		3.3	24.5
Storage areas											
Unpaved pkg lots	9.75 ac	0.5					1.2	3.0	0.4	0.4	5.5

Recap	Emissions by sector, t/yr			
	1	2 to 5	6 to 9	Total
COMBUSTION	31.6	50.8	152.1	234.5
IND PROCESSES				
FUGITIVE DUST	206.4	315.8	794.8	1,317.0
Total	238.0	366.6	946.9	1,551.5

POINT SOURCE SUMMARY

Site: Kenmore Square, Boston, Massachusetts

Plant number	Emission level, t/yr*	Distance from site, mi	Compass direction, °
0004	72.2	2.9	035
0007	24.8	3.0	105
0008	48.1	1.6	130
0009	7.2	0.65	105
0010	426.6	3.2	105
0011	62.7	2.1	055
0012	3345.9	3.2	105
0015	2034.0	2.0	125
0016	126.5	3.2	050
0018	3.8	0.83	190
0019	41.5	4.1	180
0020	27.8	0.54	290
0033	56.8	2.2	100
0036	200.8	0.90	210
0042	121.8	2.7	060
0043	205.7	3.2	105
0054	1.6	0.85	160
0058	194.9	3.0	040
0061	5.3	0.65	195
0062	37.5	3.0	105
0063	3.4	0.37	240
0072	2.5	0.71	220
0077	4.8	1.0	190
0088	426.2	4.9	240
0090	1.6	0.95	255
0092	171.9	1.5	320
0093	406.5	1.3	045
0101	0.6	0.30	135
0104	63.0	0.70	015
0128	3991.6	3.3	025
0131	27.9	4.2	020
0132	36.0	3.7	025
0199	2.4	0.27	060
0201	585.0	3.0	015
0224	405.0	2.8	290
0244	0.4	0.23	150
0250	4.2	0.21	170
0507	498.2	2.1	090
0733	2250.0	3.1	290

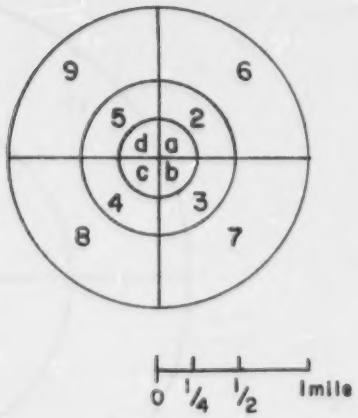
*Sources less than 25 t/yr are included with area source summary.

DESCRIPTION OF SITE

SAROAD code - 0580 006

Location - South side of Plymouth Avenue and Warren Street intersection, Fall River, Massachusetts
UTM-E-320265, N-4617277

Monitor height - Fire station roof (building recently demolished)



Land use, by sector -

1a - Dense residential
1b - Dense residential
1c - Dense residential
1d - Dense residential

2 - Dense residential
3 - Dense residential
4 - Dense residential
5 - Dense residential
6 - Central commercial, light industry
7 - Dense residential
8 - Residential
9 - Dense residential, central commercial

Localized sources, within 200 ft of monitor -

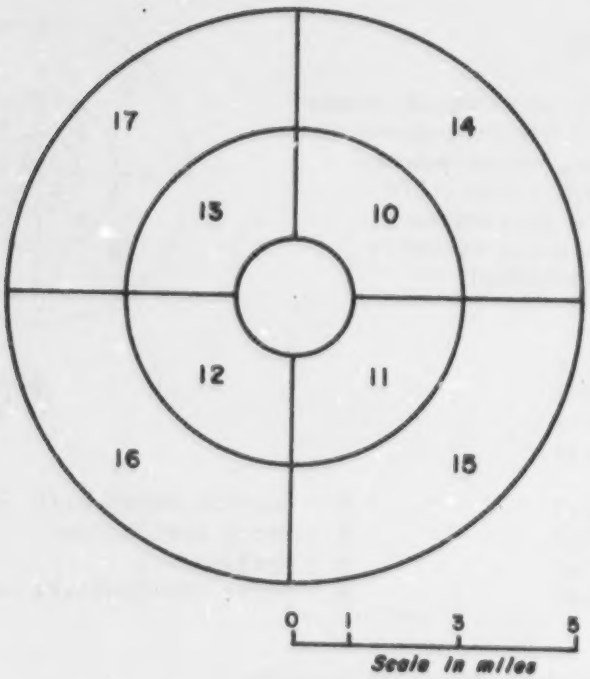
Source	Distance	Description
Plymouth Avenue	75 ft	37,000 ADT, commercial, curbed
Warren Street	50 ft	6,300 ADT, residential, curbed

Air quality data -

Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	No data	-
1976 *	58	108
1975 †	58	85
1974	No data	-
1973	No data	-

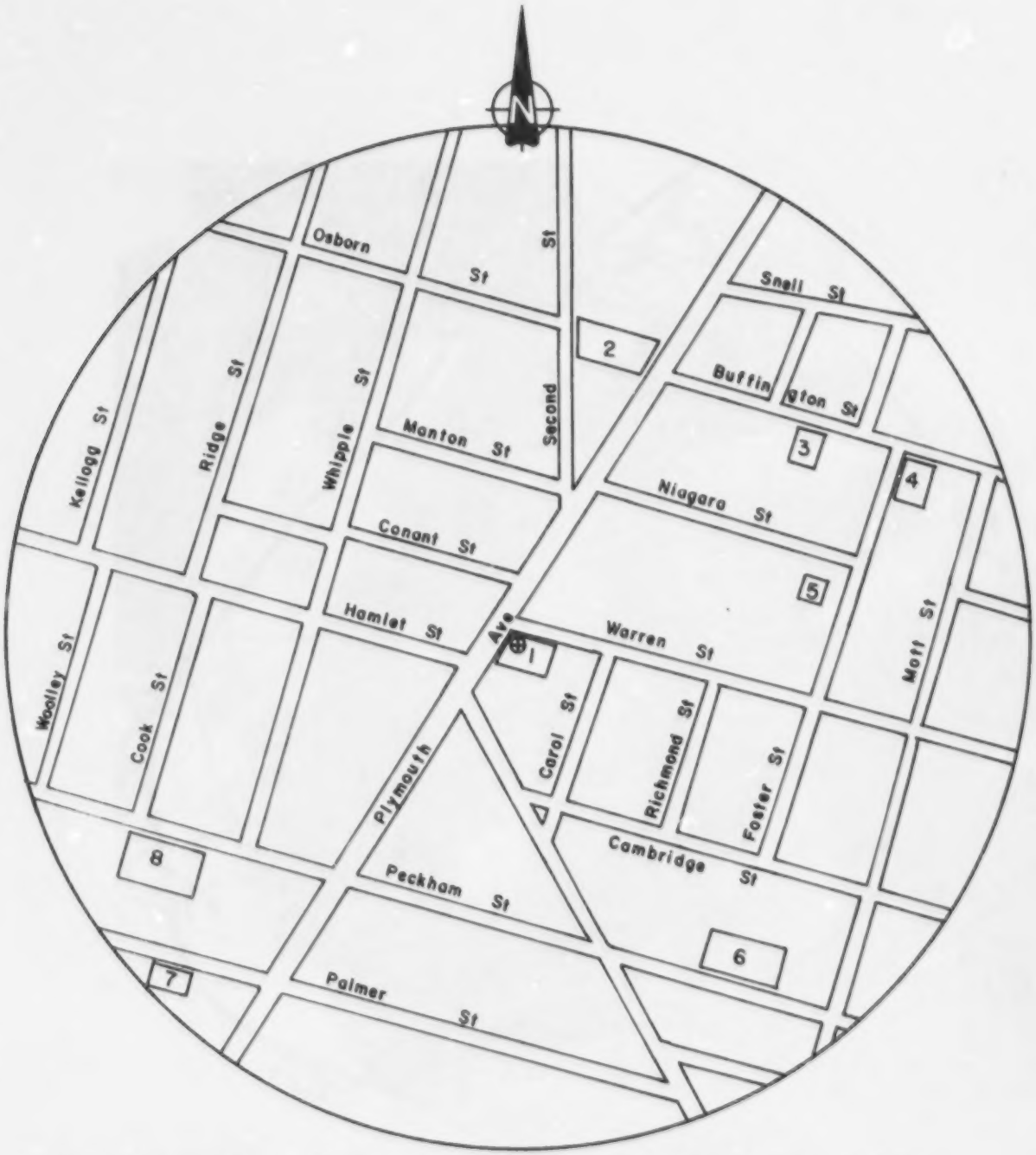
* 11 months

† 9 months



Sector	Land use	Emissions (t/yr)	
		Commercial/Industrial	Residential
10	Dense residential	19.9	12.2
11	Residential, undeveloped	11.2	3.9
12	Residential	10.3	1.9
13	Residential	17.7	1.5
14	Residential, undeveloped	12.1	4.4
15	Undeveloped	No Data	-
16	Undeveloped, residential	No Data	-
17	Residential, undeveloped	3.8	3.3

Land use and emissions by sector, Plymouth Avenue site, Fall River, Massachusetts.



1 - Construction, 0.25 ac
2 - Cleared area, 0.25 ac
3 - Unpaved parking, 0.2 ac
4 - Unpaved parking, 0.25 ac
5 - Cleared area, 0.2 ac
6 - Unpaved parking, 0.5 ac
7 - Cleared area, 0.25 ac
8 - Unpaved lumberyard, 0.5 ac

One-quarter mile radius around Plymouth Avenue site, Fall River, Massachusetts.

One-mile radius around Plymouth Avenue site,
Fall River, Massachusetts.

Plymouth Avenue, Fall River, Mass., View to Southwest.

AREA SOURCE SUMMARY

Site: Plymouth Avenue, Fall River, Massachusetts

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel	5.7×10^6 gal	0.9	0.5	0.6	0.4	0.2	0.6	1.6	1.2	0.3	6.3
Comm/Ind fuel	21.4×10^6 gal	0.9	0.6	0.7	1.2	1.6	39.7	34.0	22.8	8.2	109.7
Incinerators											
Auto exhaust	104.1×10^6 VMT	7.4	3.1	2.9	3.4	2.5	24.4	6.7	7.3	9.9	67.6
IND PROCESSES:											
Ind processes											
FUGITIVE DUST:											
Railroad yards	13 ac						neg.			neg.	neg.
Paved streets	104.1×10^6 VMT	62.5	26.0	24.8	29.1	21.3	206.5	57.0	61.8	84.3	573.3
Unpaved roads	40.7×10^3 VMT			5.9			6.6	15.3	14.1	10.6	52.5
Cleared areas	16.5 ac	neg.	neg.			neg.	neg.	neg.	neg.	neg.	neg.
Construction	2.3 ac	1.1							8.9		10.0
Storage areas	4.0 ac	neg.		0.1					0.1		0.2
Unpaved pkg lots	16.7 ac	0.5	neg.	1.0	1.8	0.3	1.4	0.5	0.5	2.6	8.6

Recap	Emissions by sector, t/yr			
	1	2 to 5	6 to 9	Total
COMBUSTION	9.2	17.7	156.7	183.6
IND PROCESSES				
FUGITIVE DUST	64.1	110.3	470.2	644.6
Total	73.3	128.0	626.9	828.2

POINT SOURCE SUMMARY

Site: Fall River, Massachusetts

Plant number	Emission level, t/yr*	Distance from site, mi	Compass direction, °
0016	15.6	0.65	080
0018	17.3	0.88	270
0019	11.6	1.8	360
0021	5.8	0.87	130
0022	23.0	0.87	130
0060	283.1	3.3	015
0061	3564.6	2.3	305
0102	7.2	0.68	040
0106	8.1	0.87	040
0123	0.6	1.5	030
0176	8.5	3.1	020
0374	600.0	4.9	330

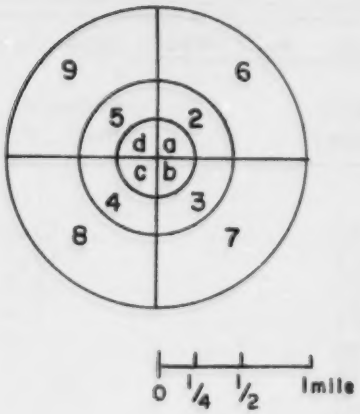
*Sources less than 25 t/yr are included with area source summary.

DESCRIPTION OF SITE

SAROAD code - 22 2160 005 F01

Location - East Columbus Avenue, Springfield, Massachusetts
UTM-E-699229, N-4663434

Monitor height - 15 ft, on trailer roof



Land use, by sector -

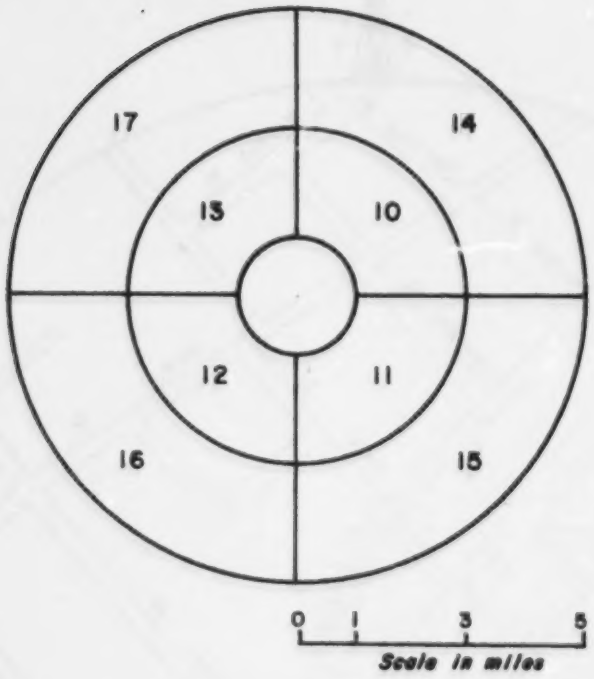
1a - Central commercial
1b - Central commercial
1c - Transportation (rail, motor vehicle), Connecticut River
1d - Central commercial
2 - Central commercial
3 - Dense residential
4 - General industry, Conn. River
5 - Central commercial
6 - Light industry
7 - Dense residential
8 - Light industry
9 - Light industry, dense residential

Localized sources, within 200 ft of monitor -

Source	Distance	Description
I-91	150 ft	64,000 ADT, Interstate highway, elevated
East Columbus Avenue	30 ft	19,000 ADT, commercial, curbed

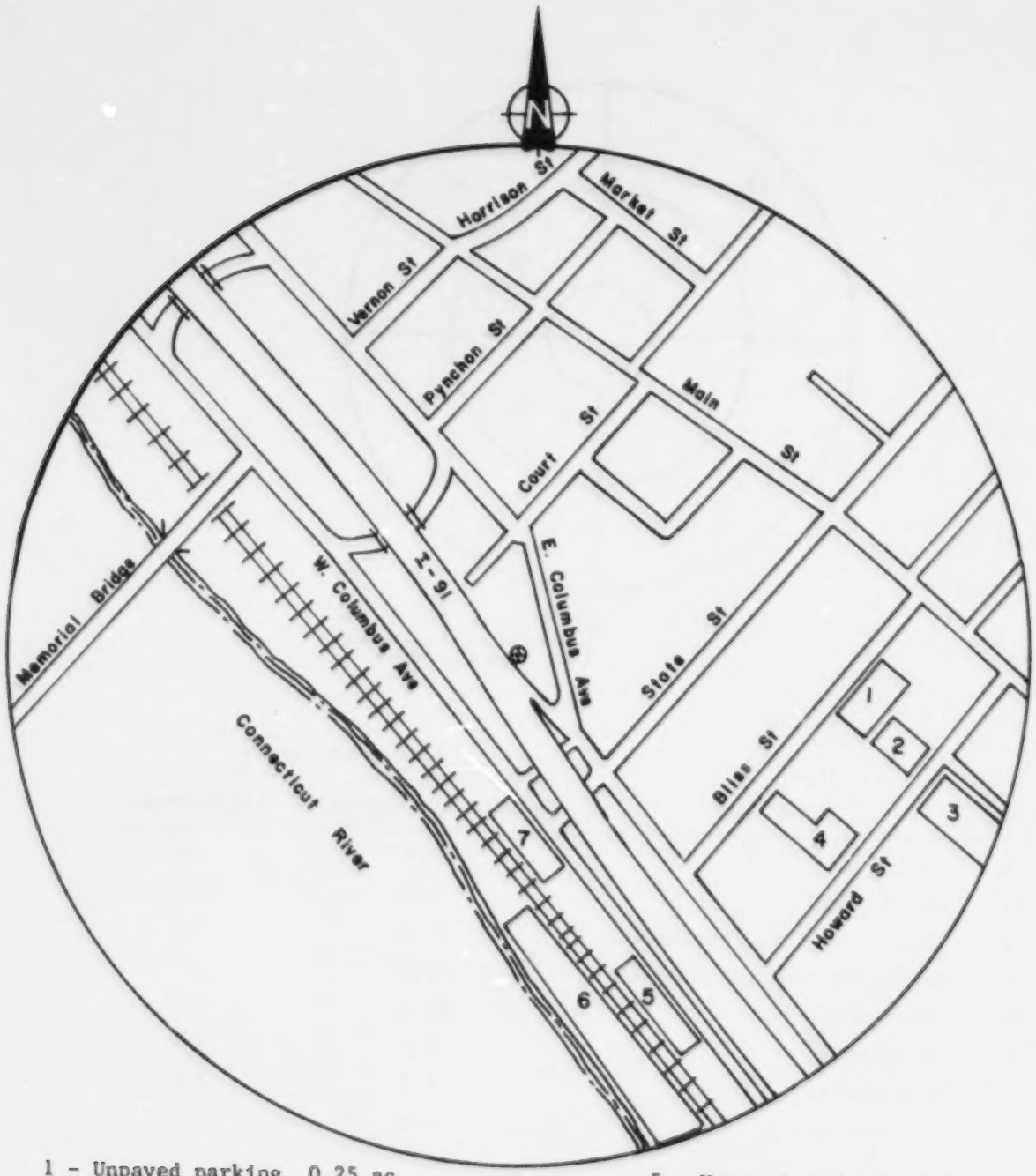
Air quality data -

Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	121	45
1976	50	57
1975	120	58
1974	65	67
1973	67	86



Sector	Land use	Emissions (t/yr)	
		Commercial/Industrial	Residential
10	Residential	39.1	6.9
11	Residential	4.8	8.4
12	Light industry, residential	17.5	5.1
13	Residential, light industry	37.0	10.0
14	Residential	26.4	7.5
15	Residential	6.7	5.7
16	Residential	4.8	2.8
17	Residential	8.6	9.4

Land use and area emissions by sector,
East Columbus Avenue, Springfield, Massachusetts.



1 - Unpaved parking, 0.25 ac
2 - Construction, 0.1 ac
3 - Unpaved parking, 0.25 ac
4 - Unpaved parking, 0.4 ac
5 - Unpaved parking, 0.1 ac
6 - Construction, 1.0 ac
7 - Construction, 0.2 ac

One-quarter mile radius around East Columbus Avenue site, Springfield, Massachusetts.

One-mile radius around East Columbus Avenue site, Springfield, Massachusetts.

E. Columbus Avenue, Springfield, Mass., View to Southwest.

AREA SOURCE SUMMARY

Site: East Columbus Avenue, Springfield, Massachusetts

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel	1.9×10^6 gal	0.1	neg.	neg.	0.1	0.1	0.5	0.6	0.1	0.4	1.9
Comm/Ind fuel	13.0×10^6 gal	2.6	1.4	1.5	1.0	4.4	18.2	1.5	4.0	3.5	38.1
Incinerators											
Auto exhaust	129.3×10^6VMT	15.0	5.5	6.7	3.5	6.0	9.4	14.0	6.0	18.1	84.2
IND PROCESSES:											
Ind processes											
FUGITIVE DUST:											
Railroad yards	46.3 ac	neg.				neg.	neg.		neg.	neg.	neg.
Paved streets	129.3×10^6VMT	126.8	46.5	56.5	29.6	50.6	79.3	118.7	50.8	153.4	712.2
Unpaved roads	1 VMT		0.5								0.5
Cleared areas	23.3 ac		neg.	neg.	neg.	neg.	neg.		0.1	neg.	0.1
Construction	4.3 ac	3.2								7.3	10.5
Storage areas	4.8 ac				neg.		neg.		0.1		0.1
Unpaved pkg lots	9.9 ac	0.5	1.2	0.7		0.1	2.2	0.1		0.4	5.2

Recap	Emissions by sector, t/yr			
	1	2 to 5	6 to 9	Total
COMBUSTION	17.7	30.2	76.3	124.2
IND PROCESSES				
FUGITIVE DUST	130.5	185.7	412.4	728.6
Total	148.2	215.9	488.7	852.8

POINT SOURCE SUMMARY

Site: East Columbus Avenue, Springfield, Massachusetts

Plant number	Emission level, t/yr*	Distance from site, mi	Compass direction, °
0016	1.0	4.2	360
0019	69.6	3.8	005
0025	1.1	4.4	135
0076	8.0	2.5	325
0081	3.0	1.1	045
0085	4.1	2.6	060
0087	6.8	2.8	050
0088	3.5	0.45	330
0089	4.3	3.3	035
0093	14.4	1.7	335
0094	4.3	0.83	035
0095	4.4	2.7	035
0096	9.7	0.73	055
0117	195.4	0.33	215
0122	10.9	2.5	270
0127	1.7	2.6	330

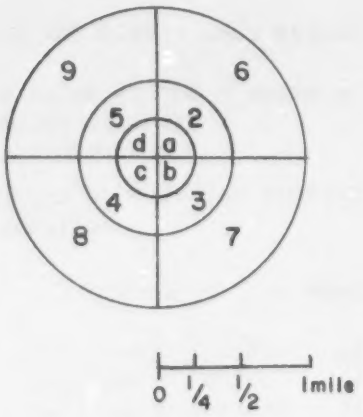
*Sources less than 25 t/yr included with area source summary

DESCRIPTION OF SITE

SAROAD code - 2640 012 F01

Location - New Salem and Washington Streets,
Worcester, Massachusetts
UTM-E-269071, N-4682192

Monitor height - 15 ft, on trailer roof



Land use, by sector -

1a - Central commercial
1b - Light industry
1c - Light industry
1d - Central commercial

2 - Light industry
3 - Light industry
4 - Light industry
5 - Dense residential
6 - Dense residential, light industry
7 - Dense residential
8 - Light industry, dense residential
9 - Dense residential

Localized sources, within 200 ft of monitor -

Source	Distance	Description
New Salem Street	30 ft	10,500 ADT, commercial, curbed
Washington Street	50 ft	2,000 ADT (estimate), commercial, below grade, curbed
Railroad right-of-way	150 ft	Number of operations unknown

Air quality data -

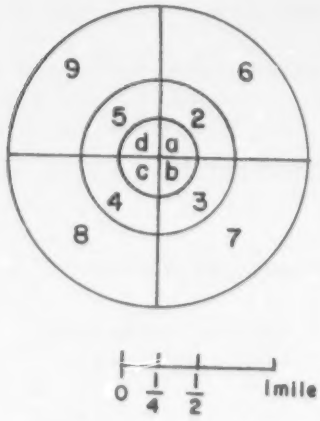
Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	89	248
1976	94	280
1975	82	60
1974	93	79
1973	94	104

DESCRIPTION OF SITE

SAROAD code - 2640 004 F01

Location - Narcus Building, Main and Front Streets, Worcester, Massachusetts
UTM-E-268835, N-4682592

Monitor height - 70 ft, roof of five-story building



Land use, by sector -

1a - Central commercial
1b - Central commercial
1c - Central commercial
1d - Central commercial

2 - Light industry
3 - Light industry
4 - Light industry
5 - Dense residential

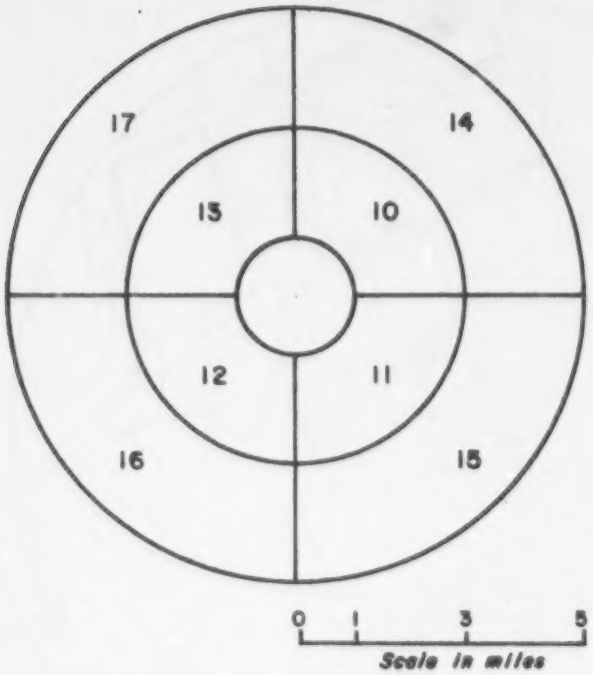
6 - Dense residential, light industry
7 - Dense residential
8 - Light industry, dence residential
9 - Dense residential

Localized sources, within 200 ft of monitor -

Source	Distance	Description
Main Street	125 ft	22,700 ADT, commercial, curbed
Front Street	90 ft	6,800 ADT, commercial, curbed

Air quality data -

Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	54	254
1976	61	257
1975	60	282
1974	70	142
1973	68	358



Sector	Land use	Emissions (t/yr)	
		Commercial/Industrial	Residential
10	Dense residential	77.6	5.3
11	Dense residential	49.9*	4.3
12	Dense residential	107.9*	5.8
13	Residential	14.5	4.3
14	Residential	16.1	7.0
15	Residential	47.4*	2.5
16	Undeveloped	12.4*	6.2
17	Undeveloped	84.1*	1.5

*Includes industrial process emissions

1. Construction, 4 ac
2. Unpaved parking, 0.1 ac
3. Unpaved parking, 0.3 ac
4. Unpaved parking, 0.4 ac
5. Cleared area, 0.4 ac
6. Unpaved parking, 1.2 ac
7. Unpaved parking, 0.2 ac
8. Unpaved parking, 1.5 ac
9. Unpaved parking, 0.1 ac
10. Cleared area, 0.3 ac
11. Unpaved parking, 0.2 ac
12. Construction, 0.25 ac
13. Construction, 0.5 ac

One-quarter mile radius around Worcester sites.

One-mile radius around Narcus Building and New Salem/ Washington Street sites, Worcester, Massachusetts.

New Salem St., Worcester, Mass., View to South.

Narcus Building, Worcester, Mass., View to West.

AREA SOURCE SUMMARY

Site: Worcester, Massachusetts (UTM-E-268953. N-4682380)

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel	3.4×10^6 gal	0.1	0.1	0.2	0.2	0.3	0.6	1.0	0.8	0.9	4.2
Comm/Ind fuel	19.6×10^6 gal	10.9	1.9	31.0	3.1	9.7	12.5	13.7	19.1	13.2	115.1
Incinerators											
Auto exhaust	141.3×10^6VMT	13.3	8.8	8.5	3.0	2.1	20.9	14.5	8.4	12.4	91.9
IND PROCESSES:											
Ind processes	1 source				10.0						10.0
FUGITIVE DUST:											
Railroad yards	39.5 ac	neg.	neg.	neg.	neg.		neg.	neg.	neg.		neg.
Paved streets	141.3×10^6VMT	112.8	74.6	71.6	25.1	18.1	177.0	122.6	70.9	105.1	777.8
Unpaved roads											
Cleared areas	30.2 ac	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.
Construction	7.5 ac	11.5	4.9						1.2	0.6	18.2
Storage areas											
Unpaved pkg lots	25.5 ac	2.1	0.8	0.7	0.1		4.8	2.2	2.5	0.1	13.3

Recap	Emissions by sector, t/yr			
	1	2 to 5	6 to 9	Total
COMBUSTION	24.3	68.9	118.0	211.2
IND PROCESSES		10.0		10.0
FUGITIVE DUST	126.4	195.9	487.0	809.3
Total	150.7	274.8	605.0	1030.5

POINT SOURCE SUMMARY

Site: Worcester, Massachusetts (UTM-E-268953, N-4682380)

Plant number	Emission level, t/yr*	Distance from site, mi	Compass direction, °
0108	1.6	0.80	085
0115	3.0	3.2	360
0116	0.4	0.95	005
0121	8.0	0.78	265
0123	13.8	0.38	110
0127	6.0	0.93	340
0130	2.0	0.56	245
0166	0.5	0.97	355
0241	1.7	0.32	325
0246	0.4	0.26	045
0248	0.1	0.90	165
0249	0.6	0.29	110
0250	0.8	0.24	180
0252	0.8	0.88	265
0253	1.5	0.71	355
0255	0.2	0.24	180
0258	0.3	0.22	235
0321	0.5	0.72	225
0322	0.7	0.15	065
0330	0.3	0.26	350
0339	1.4	0.12	270
0360	1.0	0.26	350
0363	0.6	0.61	345
0369	0.3	0.37	020
0453	0.4	0.22	235
0513	1.3	0.09	300
0519	4.6	0.82	025
0521	1.2	0.95	265
0525	1.2	0.57	190
0530	4.6	0.42	170
0531	0.2	0.54	230
0533	1.7	0.26	350
0537	0.5	0.12	175
0538	0.7	0.80	005
0539	0.7	0.31	285
0541	35.7	0.40	200
0566	0.3	0.10	010
0567	0.3	0.39	240
0574	0.4	0.35	350
0582	0.2	0.37	240

POINT SOURCE SUMMARY (continued)

Site: Worcester, Massachusetts (UTM-E-268953, N-4682380)

Plant number	Emission level, t/yr *	Distance from site, mi	Compass direction, °
0592	0.6	0.61	075
0608	0.3	0.22	005
0613	0.2	0.10	210
0614	0.4	0.12	270
0634	0.4	0.71	220
0637	10.5	0.27	110
0639	0.5	0.18	300
0640	1.3	0.37	360
0643	0.6	0.09	300
0644	0.9	0.71	355
0645	0.6	0.24	005
0652	0.7	0.12	175
0662	9.6	0.99	150
0687	0.7	0.97	355
0688	0.2	0.95	005
0689	0.6	0.50	220
0708	0.4	0.73	015
0709	0.7	0.73	015
0712	0.8	0.90	350
0713	0.5	0.88	355
0724	0.8	0.83	065
0729	0.9	0.61	260
0732	0.4	0.98	110
0736	0.5	0.73	335
0739	0.8	0.83	115
0745	0.4	0.88	190
0752	0.5	0.20	280
0757	1.2	0.87	150
0765	0.3	0.33	355
0766	0.7	0.35	350
0768	0.6	0.61	110
0769	0.7	0.77	175
0770	0.4	0.22	330
0771	0.9	0.31	100
0774	0.4	0.72	040
0780	0.6	0.48	245
0781	0.6	0.48	245
0782	1.1	0.60	290
0793	0.5	0.98	195

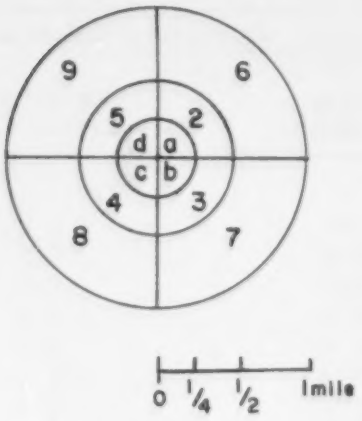
* Sources less than 25 t/yr are included with area source summary.

DESCRIPTION OF SITE

SAROAD code - 410 300 007 F01

Location - Dyer Street, I-195 Interchange,
Providence, Rhode Island
UTM-E-299912, N-4632456

Monitor height - 13 ft, on trailer roof



Land use, by sector -

1a - Central commercial
1b - General industry
1c - Light industry
1d - Central commercial

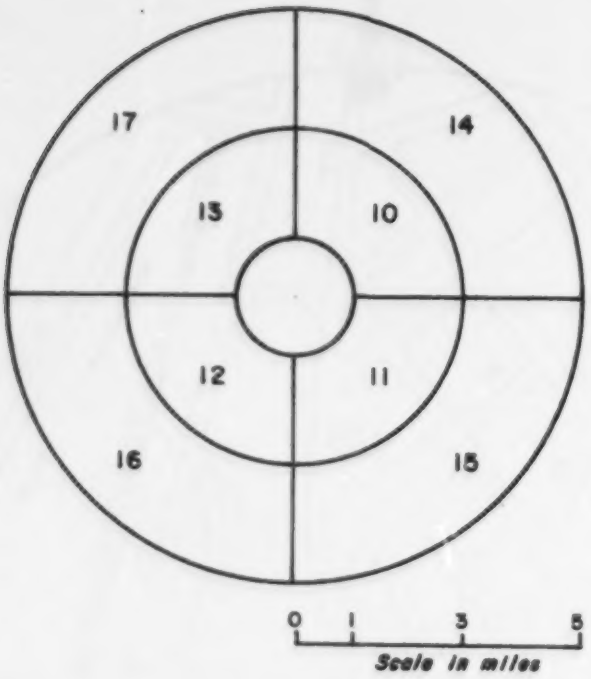
2 - Dense residential
3 - General industry
4 - Light industry, dense resid.
5 - Central commercial
6 - Dense residential
7 - General industry, Providence Harbor
8 - Light industry, dense residential
9 - Central commercial, dense residential

Localized sources, within 200 ft of monitor -

Source	Distance	Description
I-195		90,000 ADT, interstate highway
Dyer Street		5,500 ADT, commercial, curbed
I-195 ramp		6,600 ADT, commercial, curbed

Air quality data -

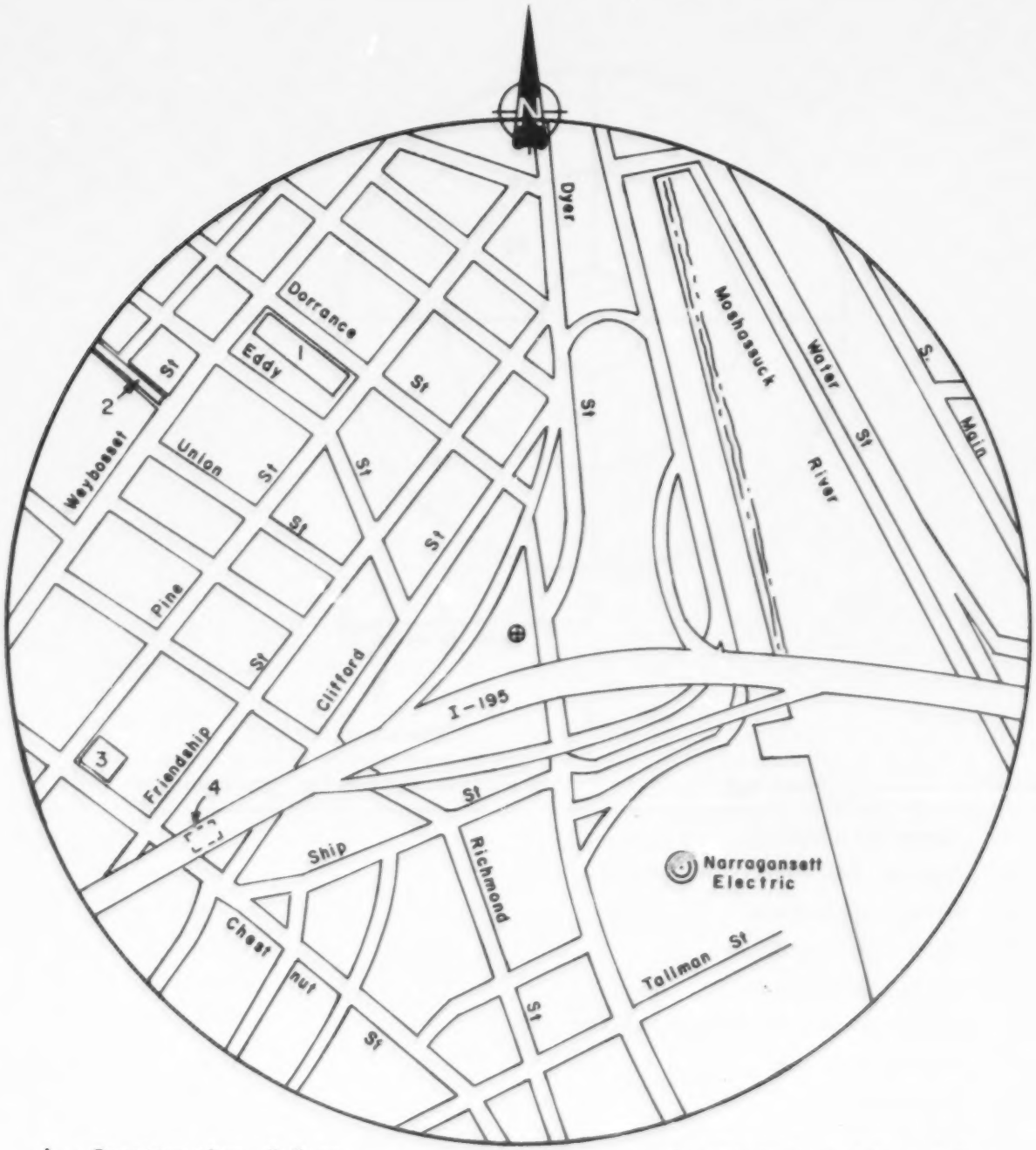
Year	Annual geometric mean, $\mu g/m^3$	No. of samples
1977	101	49
1976	92	54
1975	90	59
1974	48	42
1973	86	52



Sector	Land use	Emissions (t/yr)*	
		Commercial/Industrial	Residential
10	Dense residential	-	-
11	General industry, dense resid.	-	-
12	Dense residential	-	-
13	Dense residential	-	-
14	Dense residential	-	-
15	Dense resid., Providence Harbor	-	-
16	Residential	-	-
17	Residential	-	-

*Not available

Land use and area source emissions by sector,
Dyer Street site, Providence, Rhode Island.



1 - Construction, 2.0 ac

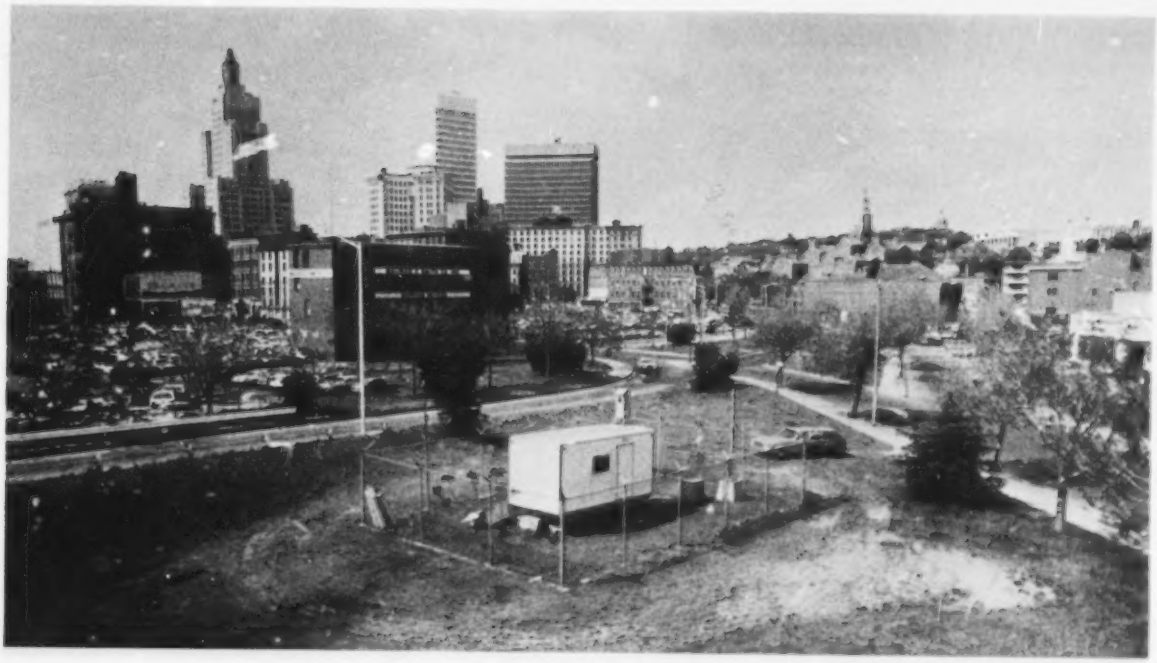
2 - Construction, 0.5 ac

3 - Unpaved parking, 0.3 ac

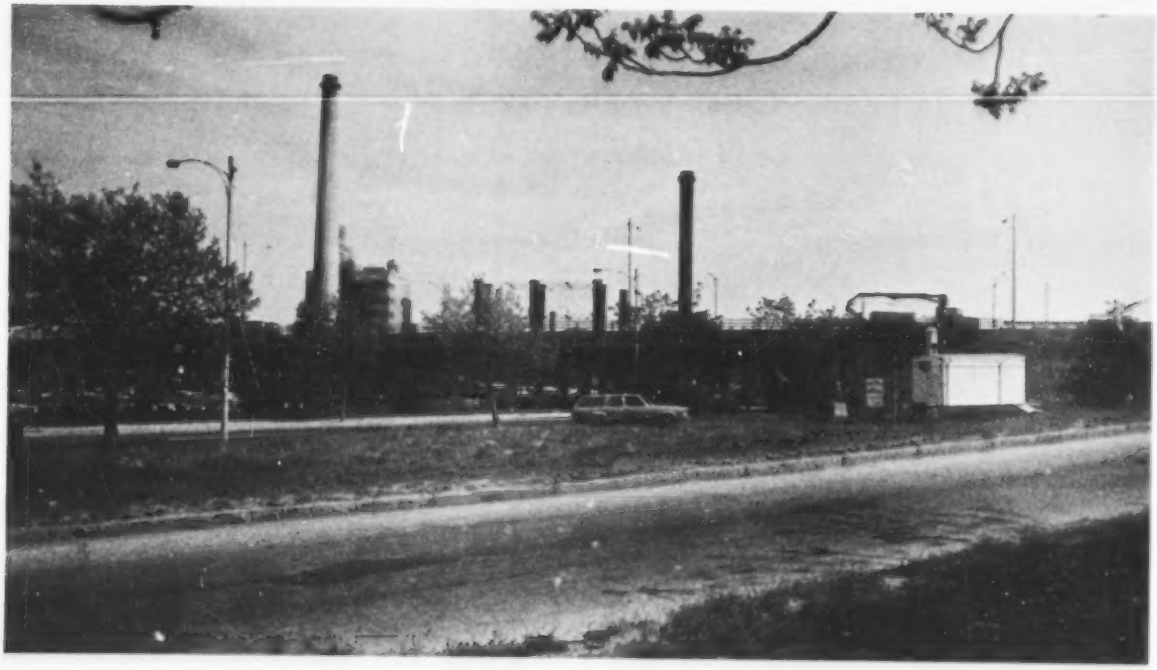
4 - Cleared area, 0.25 ac (under I-195)

One-quarter mile radius around Dyer Street site, Providence, Rhode Island.

One-mile radius around Dyer Street/I-195 site, Providence, Rhode Island.



Dyer St., Providence, R.I., View to North.



Dyer St., Providence, R.I., View to South.

AREA SOURCE SUMMARY

Site: Dyer Street trailer, Providence, Rhode Island

Source category	Activity rate	Emissions by sector, ton/yr									
		1	2	3	4	5	6	7	8	9	Total
COMBUSTION:											
Residential fuel											
Comm/Ind fuel *	41.8×10^6 gal	6.2			3.8		22.1	10.2	23.3		65.6
Incinerators											
Auto exhaust †	197.0×10^6VMT	16.5	0.8	10.3	13.8	8.7		30.6	8.0	39.5	128.2
IND PROCESSES:											
Ind processes											
FUGITIVE DUST:											
Railroad yards	19.4 ac			neg.		neg.		neg.		0.1	0.1
Paved streets †	197.0×10^6VMT	140.3	6.4	87.1	116.7	73.4		258.9	67.8	334.3	1,084.9
Unpaved roads	730 VMT				0.9						
Cleared areas	2.3 ac	neg.		neg.		neg.	neg.		neg.	neg.	neg.
Construction	14.8 ac	11.2			1.1	8.9		4.5	17.9	22.3	65.9
Storage areas	4.0 ac									0.2	0.2
Unpaved pkg lots	4.6 ac	0.2		0.1	1.2	0.1		0.5	0.3		2.4

Recap	Emissions by sector, t/yr			
	1	2 to 5	6 to 9	Total
COMBUSTION				
IND PROCESSES				
FUGITIVE DUST	152.7	295.9	706.7	1,155.3
Total				

*Point source data

†Incomplete traffic data —
Sector: 1-90%; 2-15%; 3-75%; 4-65%; 5-100%; 6- —
7-80%; 8-10%; 9-40%

POINT SOURCE SUMMARY

Site: Dyer Street trailer, Providence, Rhode Island

Plant number *	Emission level, t/yr ‡	Distance from site, mi	Compass direction, °
00037	6.16	0.20	135
00039	85.72	0.35	150
09033	3.84	0.48	195
00033	22.06	0.52	025
00043	21.36	0.69	185
167 Point St. †	1.93	0.75	185
09019	2.73	0.75	160
90000	7.50	0.95	165
00035	3.97	1.9	205
00012	9.50	2.0	090
00031	3.76	3.1	360

*Compliance Data System numbers

†Street address, no CDS number available

‡Sources less than 25 t/yr included with area source summary

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1. Pace, T. G. Microinventories for TSP. Draft Report. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

2. Thornthwaite, C. W. Climates of North America According to a New Classification. Geograph Rev. 21: 633-655, 1931.

3. Nevada Particulate Control Study for Air Quality Maintenance Areas. PED Co. Environmental, Inc., Cincinnati, Ohio. Report No. EPA-909/9-77-001. March 1977.

4. Development of a Methodology and Emission Inventory for Fugitive Dust for the Regional Air Pollution Study. Midwest Research Institute, Kansas City, Missouri. Report No. EPA-450/3-76-003. January 1976.

5. Regional Air Pollution Study Fugitive Dust Survey and Inventory. Rockwell International, Air Monitoring Center, Creve Coeur, Missouri. EPA Contract No. 68-02-2093, Task Order 24. October 1977.

APPENDIX A

SUMMARY OF DATA OBTAINED FROM STATE AND LOCAL AGENCIES

The Table below displays what data, if any, were obtained from appropriate state and local agencies. An "X" under the point or area emissions inventories indicates that these data were obtained for the site on the left. The first column under the traffic data indicates the number of street segments within a 1/4-mile radius for which traffic data were received. The second column is the number of street segments within a 1-mile radius with available traffic data.

DATA OBTAINED FROM STATE AND LOCAL AGENCIES

	Emissions inventory		Traffic data - streets within:	
	Point	Area	1/4 mile	1 mile
Bridgeport, Conn.	*	*	3	18
Hartford, Conn.	*	*	1†	2†
Waterbury, Conn.	*	*	6	14
Bangor, Maine	X	X	19	49
Boston, Mass.	X	X	13	20
Fall River, Mass.	X	X	10	32
Springfield, Mass.	X	X	11	38
Worcester, Mass.	X	X	6	34
Providence, R.I.	X	‡	12	35

*No emissions inventory (point or area) obtainable from State of Connecticut.

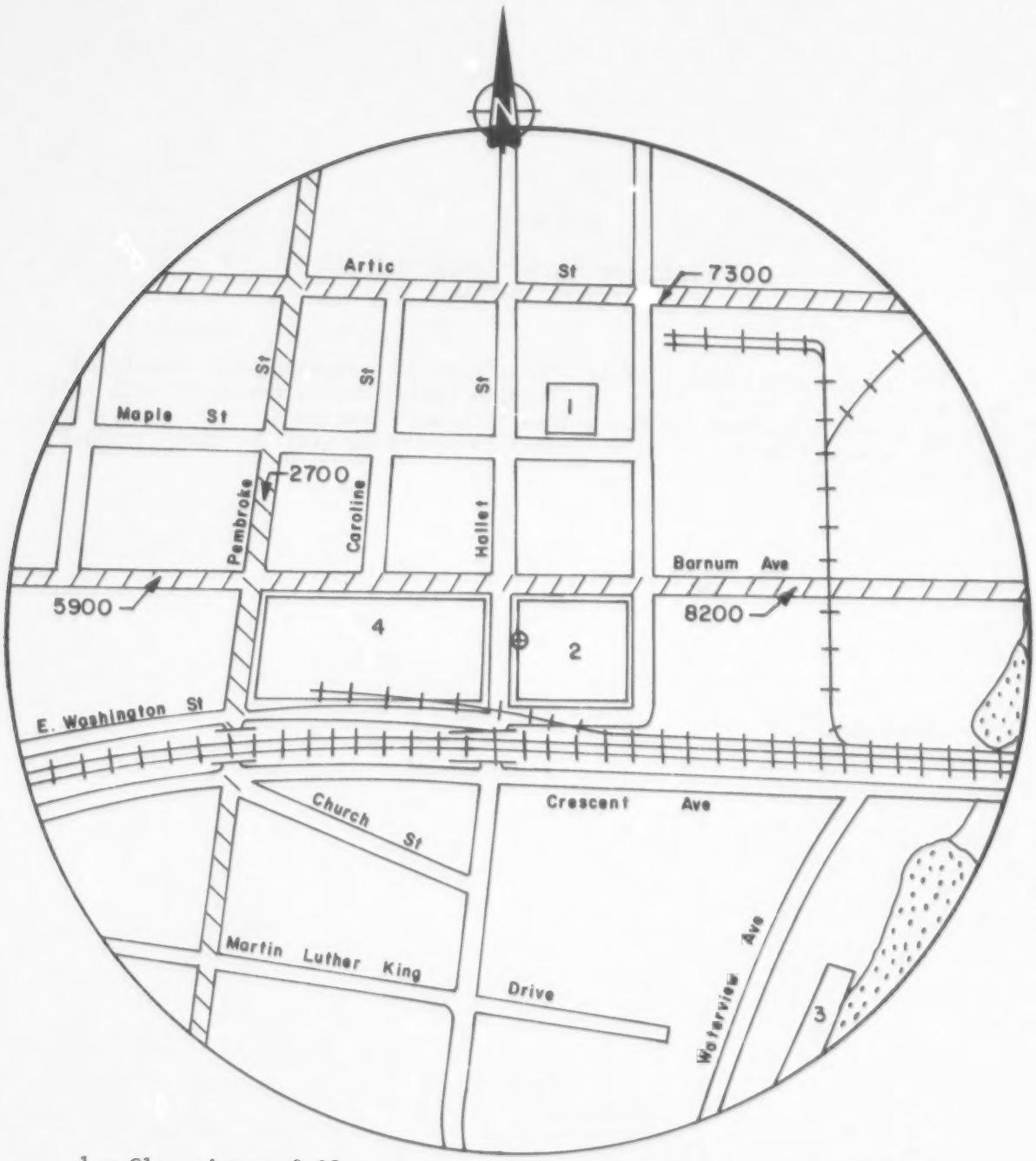
†Data available for only 2000 feet of road within 1-mile radius of sampler; considered too limited to be of value and no estimates were made.

‡Area source data available but not used, 5 square km grid considered too large.

APPENDIX B

STREETS FOR WHICH TRAFFIC VOLUME DATA WERE AVAILABLE

The streets for which traffic volume data were obtained are summarized on a site-by-site basis. First, a 1/4-mile radius map is presented with those streets shaded for which traffic volume data were available. A list of street names by sector (out to a 1-mile radius) is presented next for those streets with traffic data.



1 - Cleared area 0.25 ac

2 - Tractor-trailer training school (paved lot) 2 ac

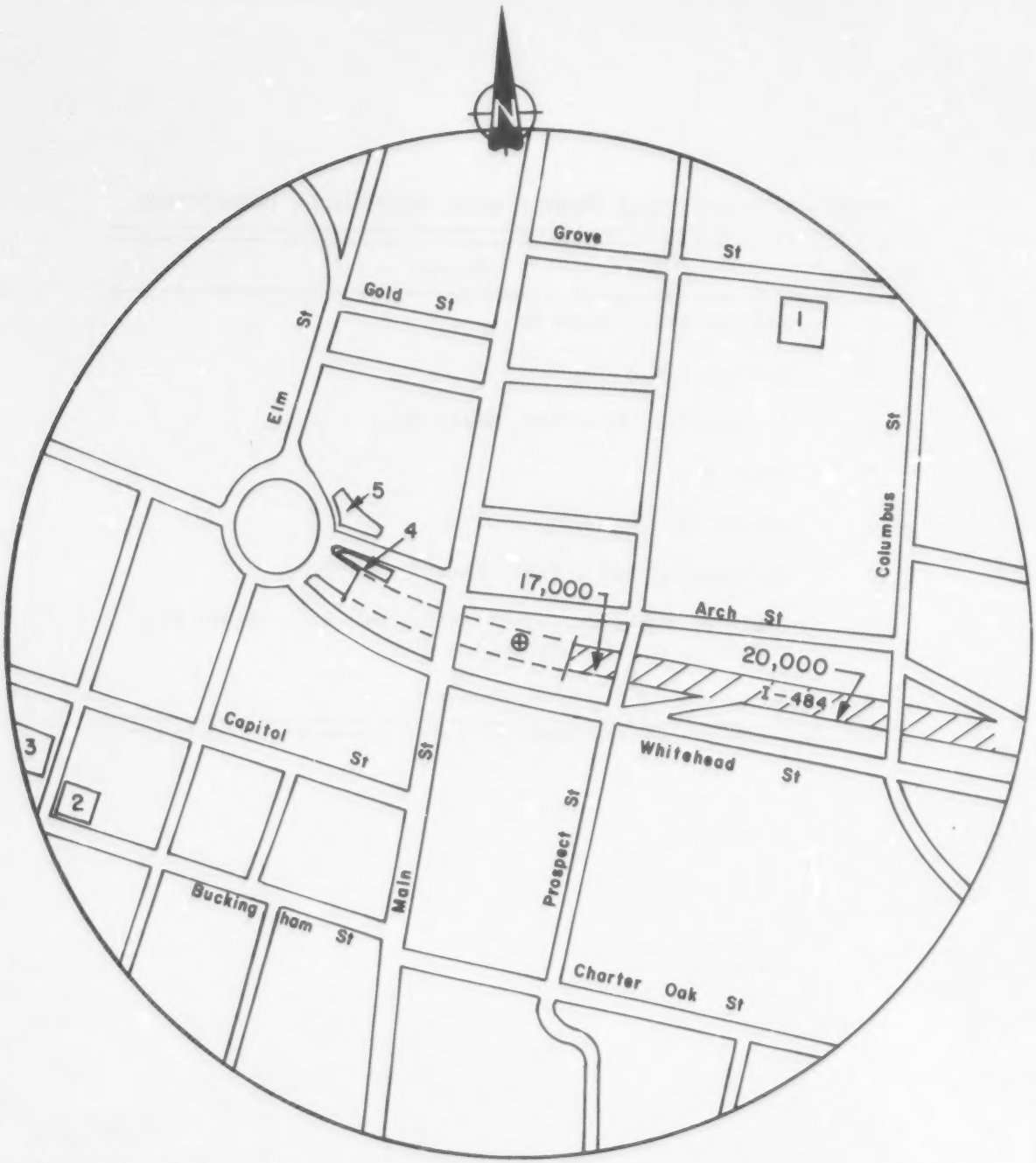
3 - Cleared area 0.25 ac

4 - Steel storage yard, 5 ac (paved lot)

Average daily traffic volume data obtained for streets within one-quarter mile radius around Hallet Street site, Bridgeport, Connecticut.

STREETS WITH AVAILABLE TRAFFIC DATA, BRIDGEPORT, CONNECTICUT

Sector	Street
2	Seaview Ave., Grant St.
3	Seaview Ave.
4	E. Main St., Kosscith, Noble Ave.
5	Noble Ave.
6	Boston Ave.
7	Connecticut Ave., I-95, Stratford Ave.
8	Route 8, Water St., I-95, Stratford Ave., State St., Congress St., E. Washington St.
9	Boston Ave., Route 8, Knowlton



1 - Cleared area, 0.25 ac

2 - Unpaved parking, 0.25 ac

3 - Unpaved parking, 0.5 ac

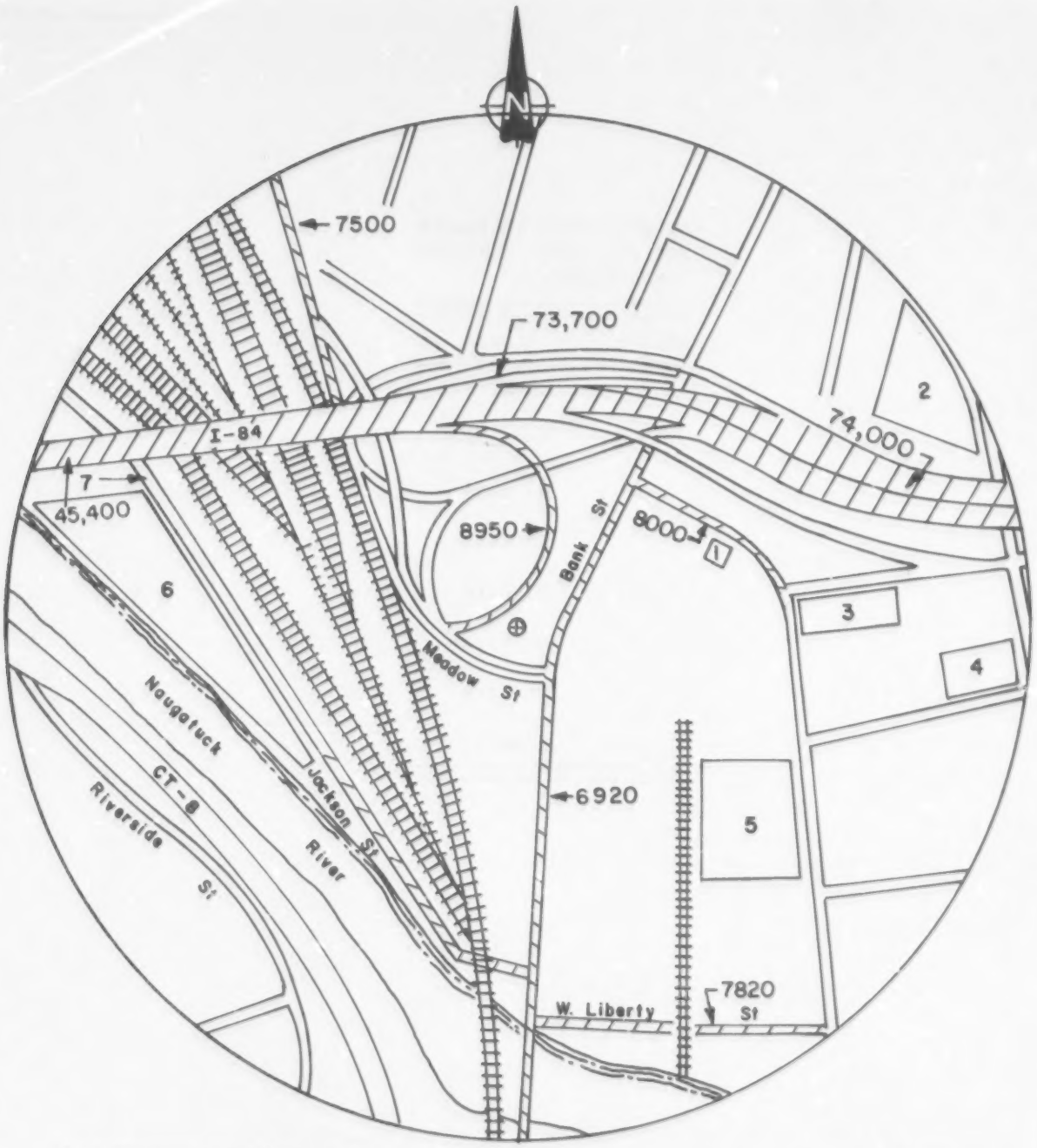
4 - Unpaved parking, 0.25 ac

5 - Construction, 0.25 ac

Average daily traffic volume data obtained for streets within one-quarter mile radius around Public Library site, Hartford, Connecticut.

STREETS WITH AVAILABLE TRAFFIC DATA, HARTFORD, CONNECTICUT

Sector	Street
2	No data
3	No data
4	No data
5	No data
6	No data
7	No data
8	No data
9	Albany Ave.

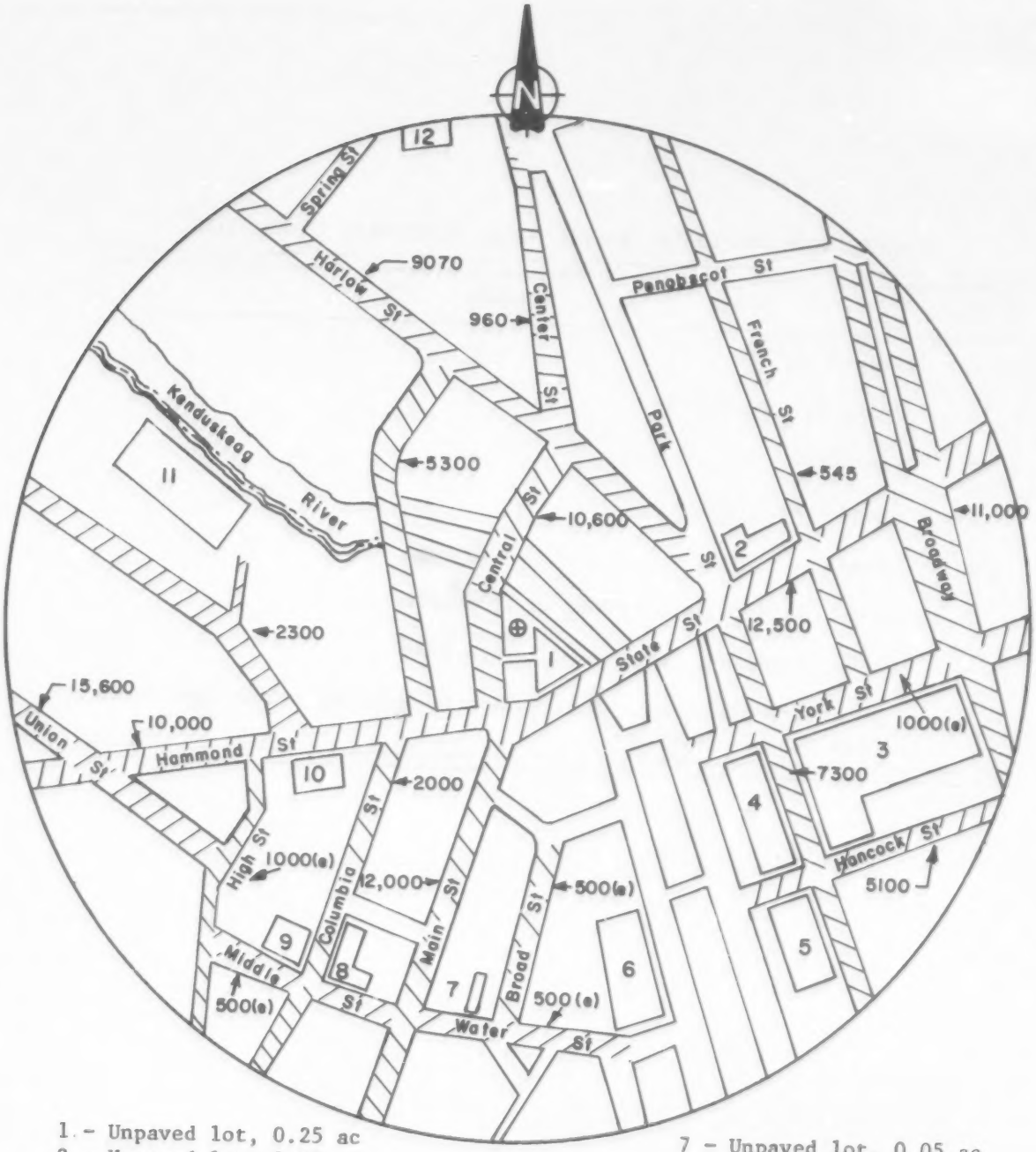


1 - Unpaved parking, 0.1 ac
2 - Unpaved parking, 1.0 ac
3 - Construction, 0.25 ac
4 - Cleared area, 0.5 ac
5 - Lumberyard, aggregate storage, 1.25 ac
6 - School bus storage, unpaved parking, 2.0 ac
7 - Dirt road, 0.1 mi

Average daily traffic volume data obtained for streets within one-quarter mile radius around I-84 Interchange, Waterbury, Connecticut.

STREETS WITH AVAILABLE TRAFFIC DATA, WATERBURY, CONNECTICUT

Sector	Street
2	I-84
3	Main St., S. Elm St.
4	No data
5	Meadow St., I-84
6	I-84
7	I-84, S. Main St., Sylvan St., Hamilton St.
8	I-84, Highland, Chipman, Chase Parkway
9	I-84, Grandview Ave., Sperry St., W. Main St., Watertown Ave., Highland, W. Robbins

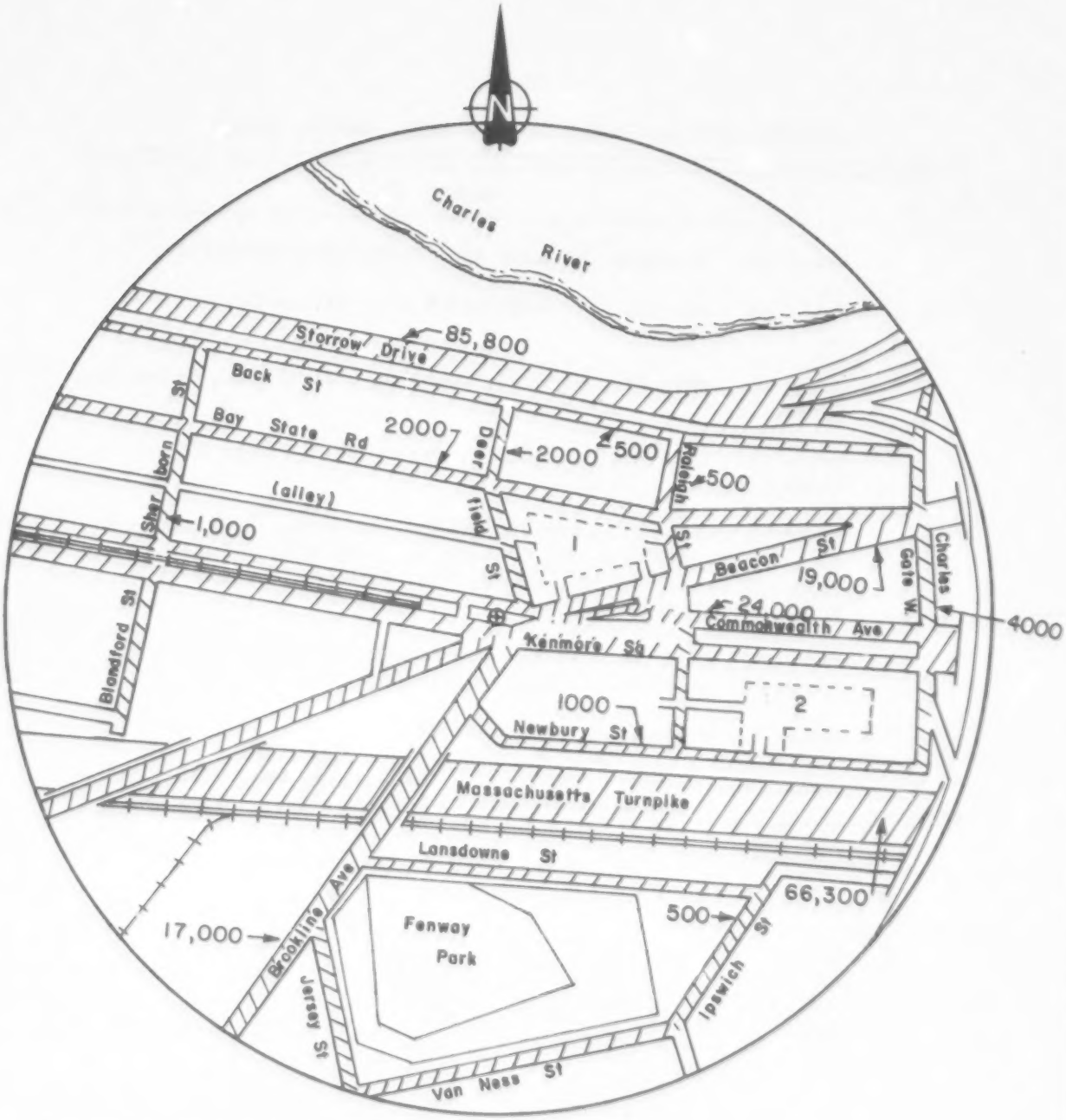


1 - Unpaved lot, 0.25 ac
2 - Unpaved lot, 0.25 ac
3 - Unpaved lot, 1.0 ac
4 - Unpaved lot, 0.5 ac
5 - Unpaved lot, 0.5 ac
6 - Unpaved lot, 1.0 ac
7 - Unpaved lot, 0.05 ac
8 - Unpaved lot, 0.2 ac
9 - Unpaved lot, 0.2 ac
10 - Unpaved lot, 0.2 ac
11 - Unpaved lot, 0.8 ac
12 - Unpaved lot, 0.1 ac

Average daily traffic volume data obtained for streets within one-quarter mile radius around 31 Central Street, Bangor, Maine.

STREETS WITH AVAILABLE TRAFFIC DATA, BANGOR, MAINE

Sector	Street
2	State St., Broadway, Hancock St., Cumberland, French St.
3	State St., Hancock St., Washington St., Wilson St., Oak St., Pine St.
4	Union St., Main St., Hammond, Third St., First St., Cedar St., Summer St.
5	Union St., Ohio St., Court St., Harlow St., Center St., Kenduskeag St.
6	Broadway, State St., Stillwater St., Mt. Hope, N. Park, Congress St., Hancock St., Essex St., Maple St., Fern St., French St., Forest St., Grove, Elm, Parkview, Pearl, Palm Fruit, Otis, Birch St.
7	Main St., State St., Wilson St., Washington St., Center St., Maple St., Parker St., Chamberlain St., Silk St.
8	Main St., Hammond St., Railroad St.
9	Union St., Ohio St., Center St., Kenduskeag St., Valley St.



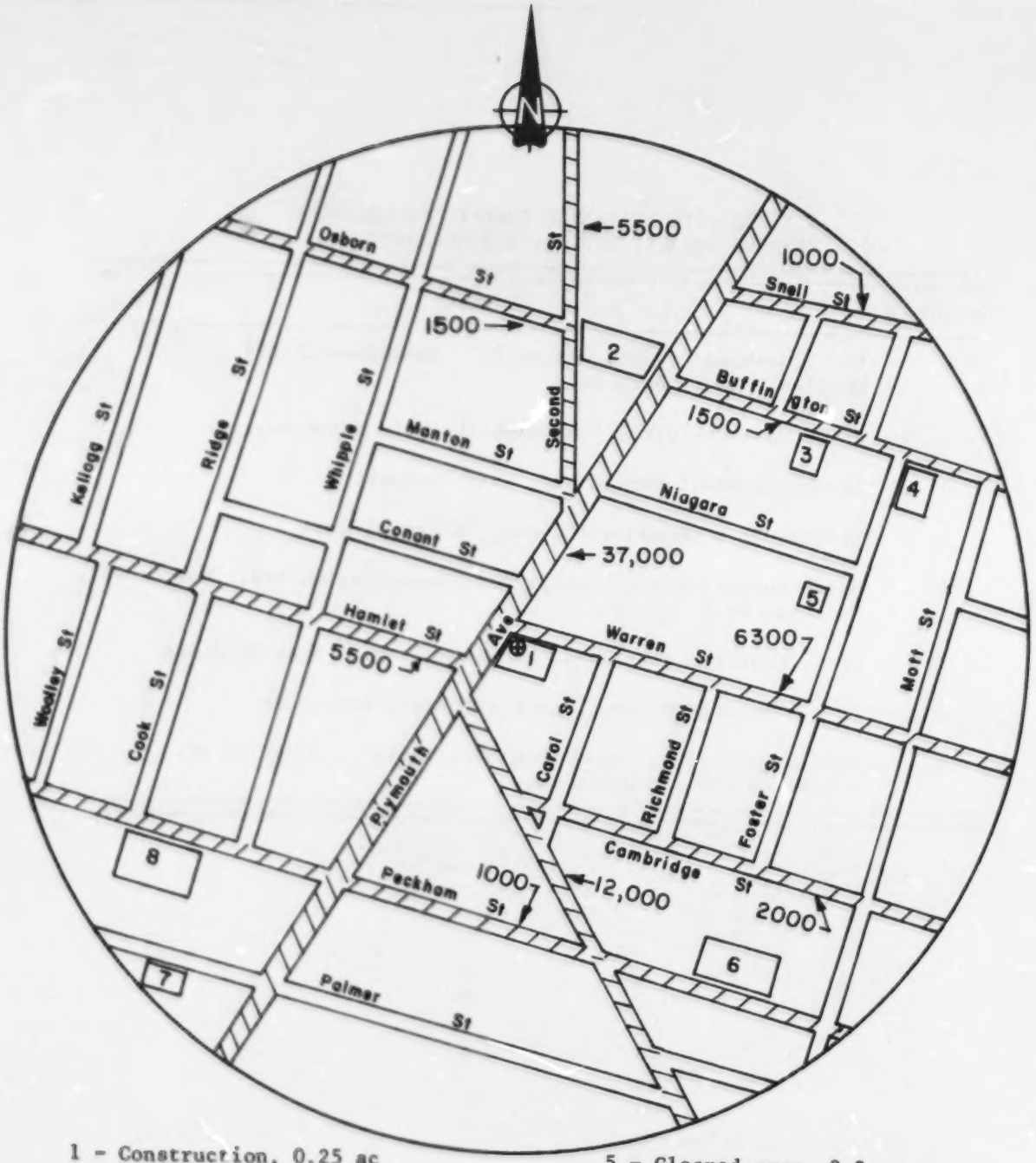
1 - Partially paved parking, 0.5 ac

2 - Partially paved parking, 0.5 ac

Average daily traffic volume data obtained for streets within one-quarter mile radius around Kenmore Square, Boston, Massachusetts.

STREETS WITH AVAILABLE TRAFFIC VOLUME DATA,
KENMORE SQUARE, BOSTON, MASSACHUSETTS

Sector	Street
2	US-1, Harvard Bridge, Beacon St., Commonwealth Ave., Charles Gate E, Back St.
3	US-1, Mass Turnpike, Commonwealth Ave., Hemmenway St.
4	Brookline Ave., Beacon St., Mass Turnpike
5	Storrow Dr., Commonwealth Ave., Memorial Dr.
6	Massachusetts Ave., Storrow Dr., Commonwealth Ave., Beacon St., Memorial Dr.
7	US-1, Massachusetts Ave., Huntington Ave., Mass Turnpike
8	US-1, Huntington Ave., Brookline Ave., Beacon St.
9	Commonwealth Ave., Mass Turnpike, Route 2, Memorial Dr., Brookline Ave., Storrow Dr.



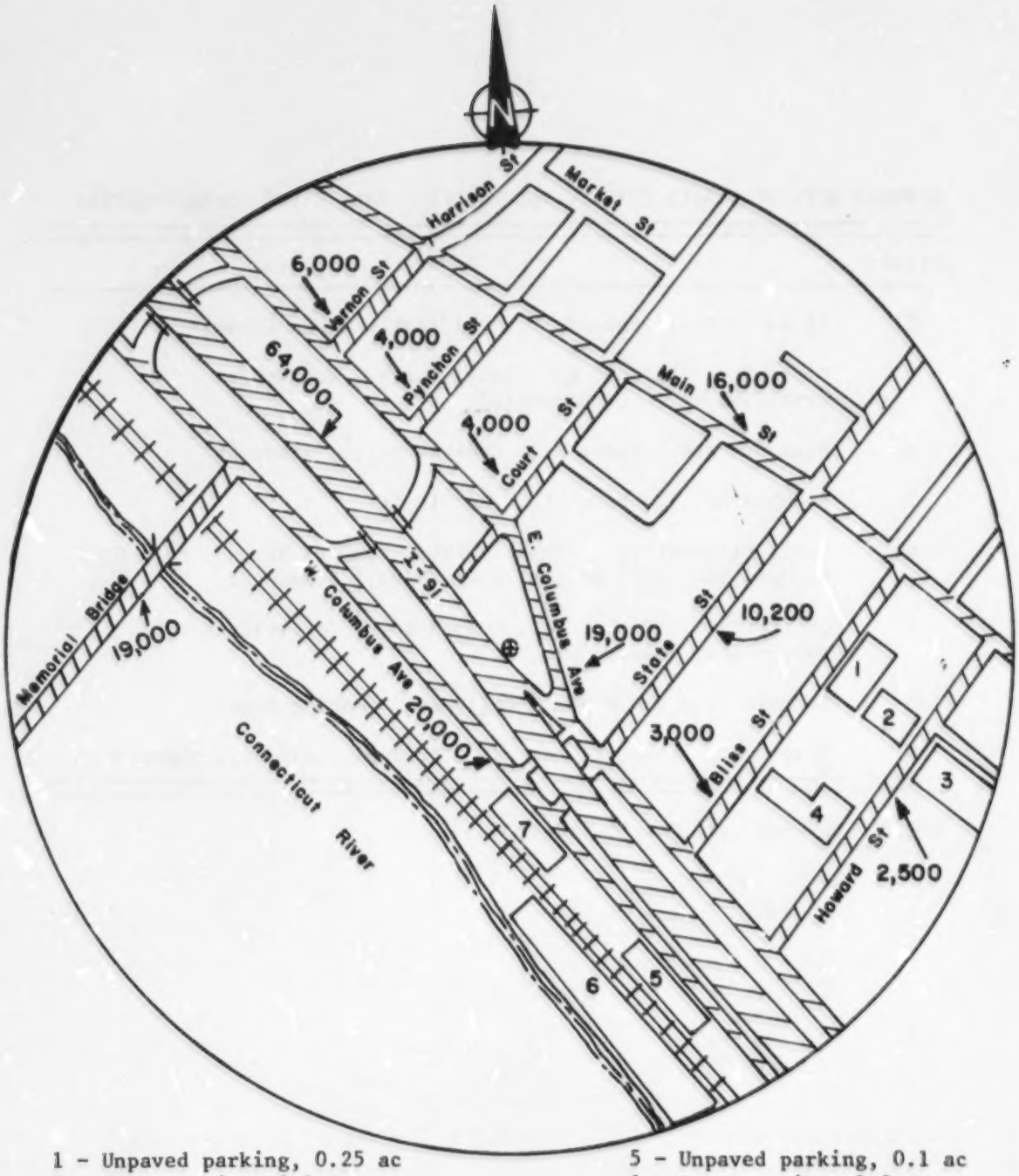
1 - Construction, 0.25 ac
2 - Cleared area, 0.25 ac
3 - Unpaved parking, 0.2 ac
4 - Unpaved parking, 0.25 ac
5 - Cleared area, 0.2 ac
6 - Unpaved parking, 0.5 ac
7 - Cleared area, 0.25 ac
8 - Unpaved lumberyard, 0.5 ac

Average daily traffic volume data obtained for streets within one-quarter mile radius around Plymouth Avenue site, Fall River, Massachusetts.

STREETS WITH AVAILABLE TRAFFIC VOLUME DATA, FALL RIVER, MASSACHUSETTS

Sector	Street
2	Plymouth Ave., Second St., Buffington St.,* Tecumseh
3	Globe St., Stafford Rd., Brayton Ave., Warren St., Cambridge St.,* Grinnel St.*
4	Plymouth Ave., Globe St., P[illegible]ham St.,* Palmer St.*
5	S. Main St., E. Main St.,* Middle St.
6	I-95, Pleasant St., Plymouth Ave., Bedford St., S. Main St., W. Main St., Rock St., Milliken Blvd,* [illegible]odman St.
7	Stafford Rd., Tucker St., Rodman St.,* Jefferson St., Warren St., Brayton Ave.
8	S. Main St., Globe St., Dwelly St., Canning Blvd.
9	Middle St., I-95, S. Main St., Broadway, Bay St., Chace St.

*Traffic volumes used were estimated.

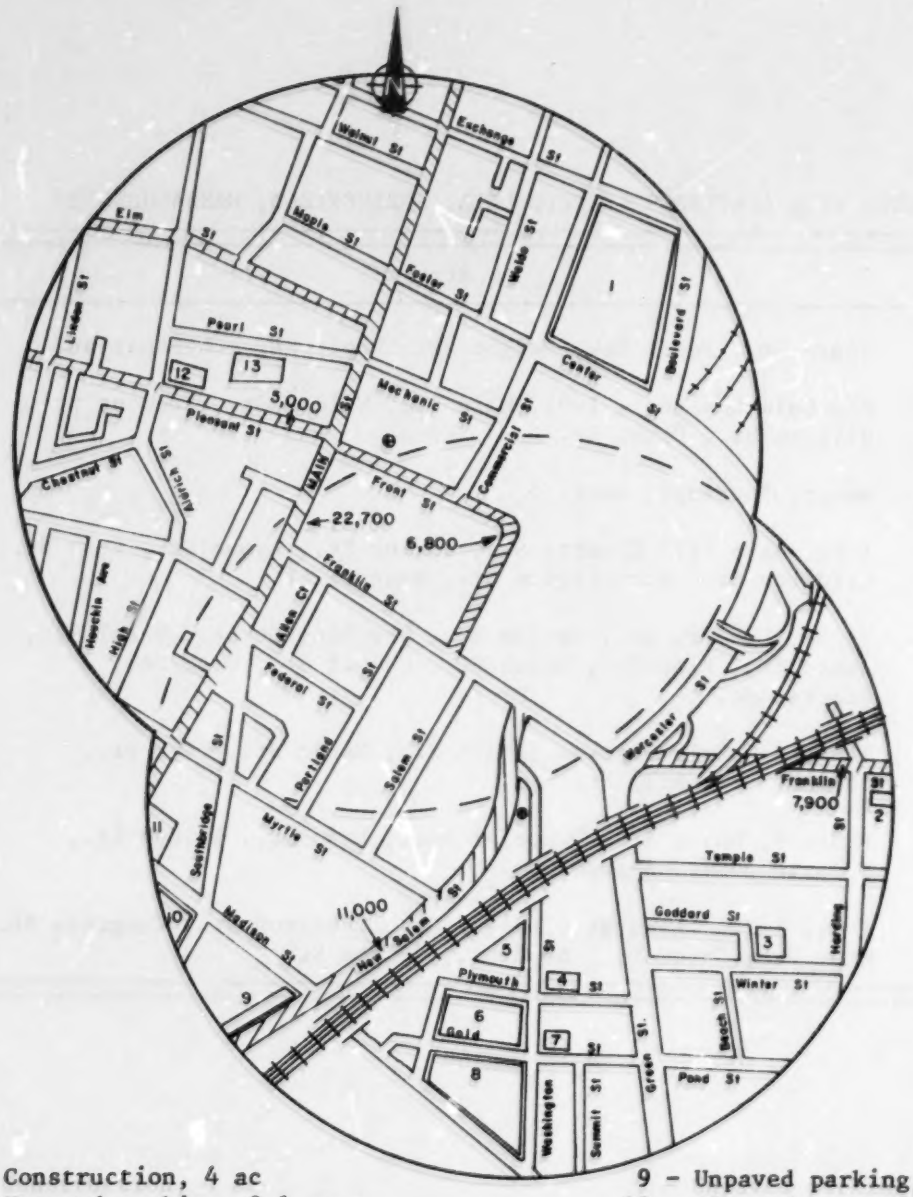


1 - Unpaved parking, 0.25 ac
2 - Construction, 0.1 ac
3 - Unpaved parking, 0.25 ac
4 - Unpaved parking, 0.4 ac
5 - Unpaved parking, 0.1 ac
6 - Construction, 1.0 ac
7 - Construction, 0.2 ac

Average daily traffic volume data obtained for streets within one-quarter mile radius around East Columbus Avenue site, Springfield, Massachusetts.

STREETS WITH AVAILABLE TRAFFIC DATA, SPRINGFIELD, MASSACHUSETTS

Sector	Street
2	State St., Pearl St., Dwight St., Maple St., Chestnut St.
3	E-W Columbus Ave., I-91, Main St., Wilcox St., Fremont St., William St., Union St.
4	Memorial Bridge, Route 5
5	I-91, Main St., Liberty St., Taylor St., Lyman St., Fort St., Gridiron St., Worthington St., Hampden St.
6	I-291, Liberty St., Taylor St., Worthington St., Pearl St., State St., Pine St., Union St., Walnut St., High St., Federal St.
7	I-91, E-W Columbus Ave., Main St., Maple St., Pine St., Central St., Mill St.
8	Route 5, Union St., Memorial Ave., Main St., Bridge St., N. Bridge St., Agawam Ave.
9	I-91, I-291, Main St., Dwight St., Chestnut St., Congress St., West St., Carew St., Bond St., Patton St.

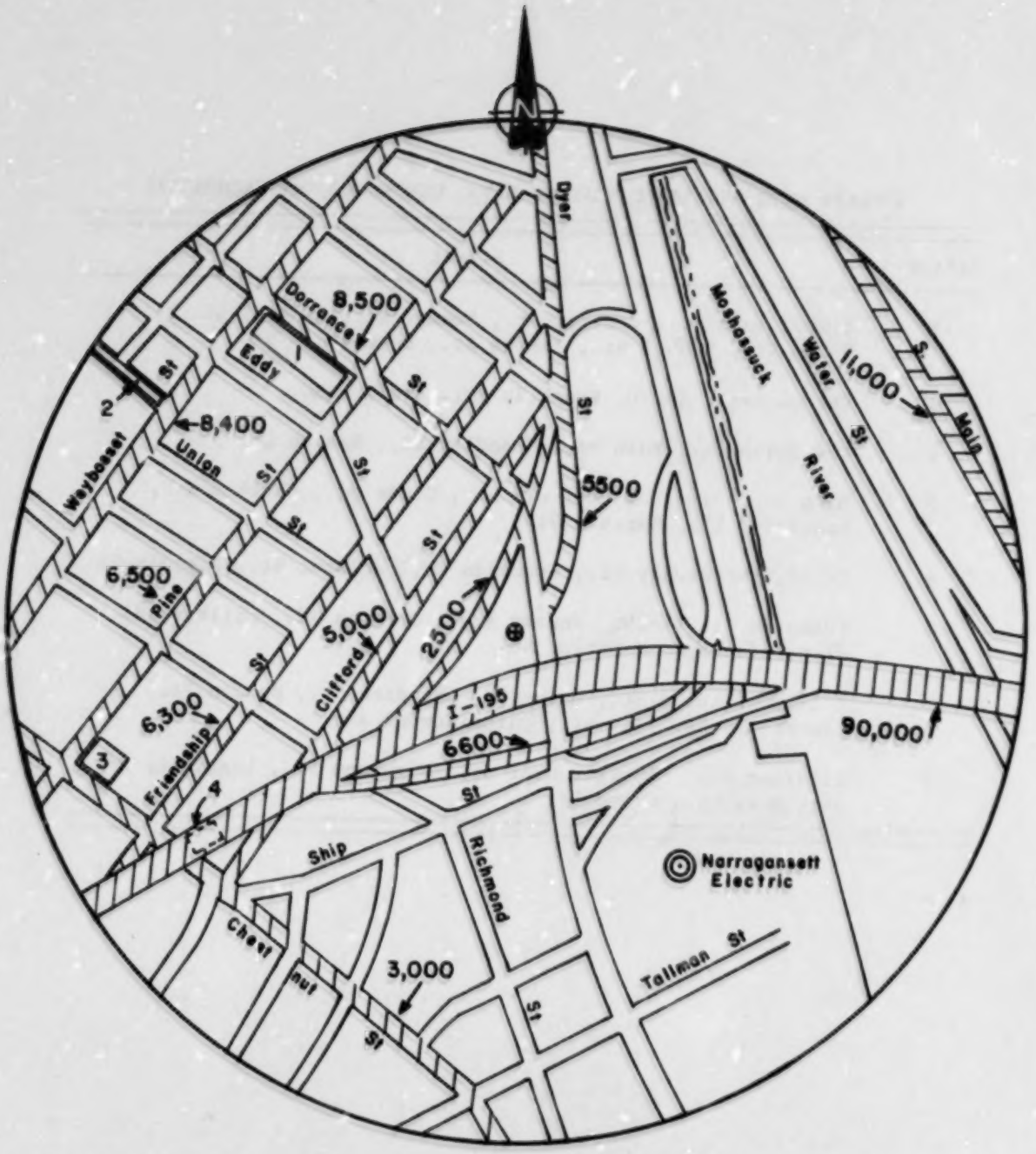


1 - Construction, 4 ac
2 - Unpaved parking, 0.1 ac
3 - Unpaved parking, 0.3 ac
4 - Unpaved parking, 0.4 ac
5 - Cleared area, 0.4 ac
6 - Unpaved parking, 1.2 ac
7 - Unpaved parking, 0.2 ac
8 - Unpaved parking, 1.5 ac
9 - Unpaved parking, 0.1 ac
10 - Cleared area, 0.3 ac
11 - Unpaved parking, 0.2 ac
12 - Construction, 0.25 ac
13 - Construction, 0.5 ac

Average daily traffic volume data obtained for streets within one-quarter mile radius around Worcester sites.

STREETS WITH AVAILABLE TRAFFIC DATA, WORCESTER, MASSACHUSETTS

Sector	Street
2	I-290, Main St., Central St., Summer St., Central St. E., Union St., School St., Thomas St., Shrewsbury St.
3	Vernon Ave., I-290, Franklin St., Grafton Rd.
4	New Salem St., Main St., Chandler St., Beacon St.
5	Main St., Pleasant St., Elm St., Cedar St., Chatham St., Lancaster St., Harvard St.
6	I-290, Shrewsbury St., Franklin St., Belmont St., Lincoln St.
7	Franklin St., I-290, Vernon Ave., Grafton Rd., Millbury St., Plantation St., Hamilton St.
8	I-290, Millbury St., Main St., Chandler St., Beacon St., Canterbury St., May St., Quinsigamond Ave.
9	Pleasant St., Elm St., West St., Highland St., Institute Rd., Salisbury St., Grove St.



1 - Construction, 2.0 ac

2 - Construction, 0.5 ac

3 - Unpaved parking, 0.3 ac

4 - Cleared area, 0.25 ac (under I-195)

Average daily traffic volume data obtained for streets within one-quarter mile radius around Dyer Street site, Providence, Rhode Island.

STREETS WITH AVAILABLE TRAFFIC DATA, PROVIDENCE, RHODE ISLAND

Sector	Street
2	Waterman St., N. Main St., Dyer St.
3	I-195, Wickendon, I-95
4	I-195, I-95, Franklin St., Claverick St., Greene St., Chestnut, Empire, Washington, Broad St., Pine St., Weybosset St.
5	Washington St., Fountain St., Waterman St., Westminster St., Sabin St., Broadway, Exchange St., Green St., Terrace St., Empire St., Mathewson St., Eddy St., Dorrance St., Promenade St., Main St.
6	No data
7	I-95, I-195, Eddy St.
8	I-95, Franklin St., Washington St., Broad St., Pine St.
9	I-95, Franklin St., Broadway, Exchange St., Kinsley, Promenade St., Gaspee St., Main St., Smith St.